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Science Education

The Science Magazine for All Science Teachers

Formerly General Science Quarterly

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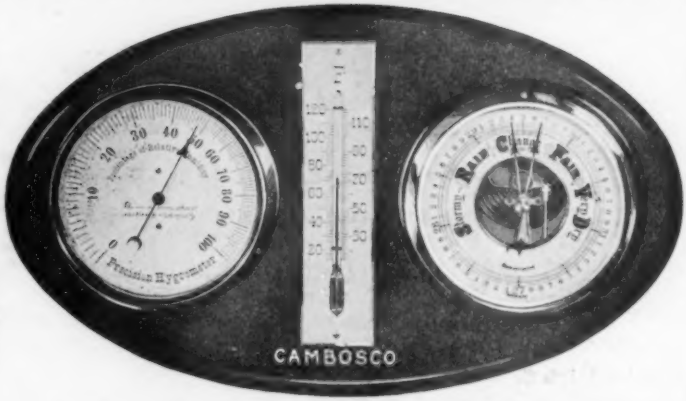

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Program of the Atlantic City Meeting of the National Association for Research in Science Teaching

Monday Morning, February 24th, 1930

9:30 A. M.

RITZ-CARLTON HOTEL, VALENCIA ROOM

MR. W. L. EIKENBERRY, *President*

1. A Technique for Developing Content for a Professional Course in Science for Teachers in Elementary Schools.
   FLORENCE G. BILLIG, *Supervisor of Science, Sacramento, California.*

2. A Program of Research in Science Teaching, with Reports of Accomplishments and Work in Progress.
   S. R. POWERS, *Professor of Natural Sciences, Teachers College, Columbia University.*

3. Science Information of General Science Teachers.
   RALPH K. WATKINS, *Associate Professor of Education, University of Missouri.*

4. Survey of Science in Elementary Schools of the United States.
   E. L. PALMER, *Professor of Rural Education, Cornell University.*

5. Interest and Achievement in Science.
   A. W. HURD, *Research Associate, Institute of Experimentation, Teachers College, Columbia University.*

6. Objective Tests—Physics.
   E. E. WILDMAN, *Director of Science Education, Philadelphia, Pennsylvania.*

7. General Science Outfits.
   J. R. LUNT, *Director of General Science, Boston City Schools.*

8. Present Objectives in Biology.
   E. C. PERSING, *Assistant Professor of Elementary Science, Western Reserve University.*

DINNER MEETING

Monday Evening, February 24th, 1930

6:30 o'clock

For Members Only

RITZ-CARLTON HOTEL, BLUE ROOM

Business Meeting

General Discussion of work in the field. No set speeches. Everyone is encouraged to participate. The following questions have been given in response to the inquiry sent out by the Secretary. They are listed here for suggestion.

1. What constitutes a satisfactory program of required elective courses for the training of high school teachers in science?
2. Is the elective system of courses in science accomplishing what it should in the way of educating children in this field?
3. What should be the specific objectives of science teaching in the elementary school?
4. What recommendations may be made for improving the methods used by colleges for certifying high school science courses?
5. What objectives should guide in the planning of a correlated sequence of science in elementary and secondary schools?
6. Are existing science tests adequate for the purposes for which they were prepared?
7. Is laboratory work rated equitably in determining the teacher's load?
8. Is there a field in the state teachers college for the so-called survey course?
9. What should constitute the laboratory instruction in general science?
10. Is there need for a closer correlation of the work in science in the secondary schools with the other subjects that are offered?
11. What should constitute the program of teacher training for junior high school teachers of science?

Tuesday Morning, February 25th, 1930

9:30 A. M.

RITZ-CARLTON HOTEL, VALENCIA ROOM

MR. W. L. EIKENBERRY, *Presiding*

1. A Comparative Study of Regent Examinations and Standard Tests as Measures of Ability in Chemistry and Physics.
   W. W. KNOX, *Supervisor of Science, State of New York.*

2. Relation of Intelligence Ratings to Science Subjects studied in Certain Schools.
   OTIS W. CALDWELL, *Professor of Education, and Director of the Institute of School Experimentation, Teachers College* and
   JOSEPH N. GAMBLE, *Research Assistant, Columbia University.*

3. Superstitions of the Fox River Valley, Wisconsin.
   J. O. FRANK, *Professor of Science Education, Wisconsin State Teachers College.*

4. The Mathematics Used in Inorganic Chemistry Textbooks.
   H. A. WEBB, *Professor of Teaching of Chemistry, George Peabody College for Teachers.*

5. The Failure of the Elective System in High Schools to Produce any Reasonable Program of Science Instruction.
   E. R. GLENN, *New Jersey State Teachers College, Montclair, New Jersey.*

6. Tests in General Science
   J. A. HOLLINGER, *Director of Department of Science, Pittsburgh Public Schools, Pennsylvania.*

7. The Advantages of 80-minute Periods in Summer Courses in General Science.
   W. F. ROECKER, *Chairman, Science Department of Boys' Technical High School, Milwaukee, Winconsin.*

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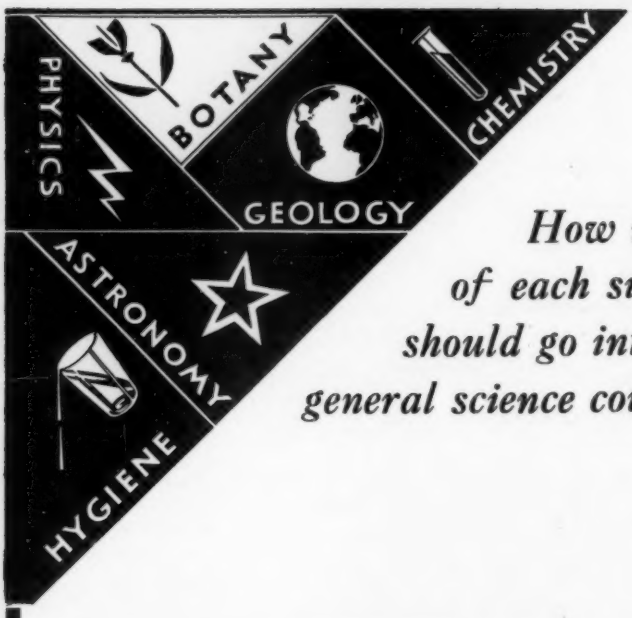

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(Formerly GENERAL SCIENCE QUARTERLY)

Vol. XIV JANUARY, 1930 No. 2

Providing for Individual Differences in the General Science Class

FRANCIS D. CURTIS, University of Michigan

The success of the teacher of general science, as in fact of all subjects, lies in his ability to adjust the materials of instruction to the individual differences of the pupils. In very small groups, such adjustment is relatively simple; but in large classes, which are coming to be the standard in our high schools, the problem of individual adjustment becomes discouragingly complicated. Large school systems attempt a practical solution of this problem by sectioning the groups on the basis, usually, of intelligence. Smaller systems, however, cannot attempt ability grouping. Such practice even where it is practicable affords only a partial and far from satisfactory adjustment, since homogeneous grouping merely limits the range of individual differences within the group and then with respect only to the one trait which has been made the basis for the grouping. Even in a "dull" or a "bright" group there are as many different individuals as there are pupils, each presenting his own instructional problems.

In most classrooms there is probably little attempt upon the part of the teacher to adjust the work specifically to the individual pupils. The class is usually taught as a whole. In a majority of classes, however, it is common to find the work best adjusted to the sub-average intelligence level within the class. Such individual adjustment as is made is usually in the form of "special help" for the dullest members. The least intelligent pupils most frequently receive this special favor not only because the brighter ones learn the materials without extra help, but also because in the too common opinion both of

teachers and patrons of the school, it is considered the more praiseworthy pedagogical practice for the teacher to devote most of his time and energy to those least capable of profiting by this help.

Merely to deplore the deficiencies of individualized instruction serves no purpose. The question immediately arises, How can the situation be improved? It is impractical to suggest that this problem can be solved by segregation because segregation is impossible in the great majority of schools; whatever is done must be accomplished within each class, however large the class may be. We must look to the results of educational research for practical ways and means of making individualized instruction effective. Fortunately, although scientific investigation (in the modern sense) in the teaching of science is barely twenty years old, some light has already been thrown upon practical ways and means of meeting individual differences. The following discussion aims to deal very briefly with a few of these.

SUBJECT-MATTER. The earlier textbooks in general science were relatively thin books, in many of which most of the space was devoted to the particular branch of science in which the author had specialized. With the attempts to make of general science a better "exploratory course" by including in it an adequate introduction to a wide variety of scientific courses, authors of more recent books in this subject have of necessity expanded their materials several hundred pages. The result is that it is probably not possible for even the brightest pupils in the class to master all of the materials in any modern general science text, while the average pupil can hardly be expected to master much more than half of it. Yet the teacher, because of administrative pressure or because he does not know what else to do, often attempts to "teach everybody everything in the book" with the inevitable result that the pupils fail to secure optimum values from the course.

The fault lies not in the amount of material in the textbook but in the way in which it is used. The remedy lies in providing for each pupil an amount appropriate to his abilities, judged not by an intelligence test administered beforehand, but by his success in mastering the materials as he progresses through the course.

Before the term starts, the teacher or a committee of teachers

of the subject should decide upon a core of minimal essentials of subject-matter. These minimal essentials should be chosen in terms of topics rather than of pages of text; a list of topics to serve as a basis of selection will be found in a recent research monograph.[1] With a dull group the list of required topics for the course should be relatively short, since all the pupils should be expected to master it; with a bright group it can be made much longer.

Where a single textbook is used, the paragraphs dealing with the selected list of essential topics should be marked in the teacher's desk-copy. This statement does not mean that these paragraphs should be picked out of the body of the text, to be taught separately, one at a time. Such a practice would not only render the subject meaningless and uncoördinated, but it would make difficult, if not impossible, adequate provision for the needs of the abler pupils in the class. Every pupil, as the course progresses, should *read* the entire book in order to gain a proper orientation and conception of the subject as a whole. But as the material is studied, the teacher should indicate to the pupils exactly which paragraphs they are *all* expected to master as minimal essentials. It is his business then to insure that these minimal essentials for the dullest pupils do not become the maximal goal for all the pupils. As he becomes acquainted with his class by working with them he begins to assign to the more capable members additional paragraphs and sections, for a complete and accurate knowledge of which they will be held responsible.

Where a syllabus is used instead of a single textbook, it will probably be found most satisfactory to have the syllabus follow some one basic textbook, or at least the general organization of one text, and to use other textbooks and supplementary materials for enrichment and extension. Such a plan provides a more coherent thread of continuity than is possible, and prevents much confusion which is inevitable, when the pupils are directed first to one book and then to another, each of which makes use of and reference to a different selection and sequence of preceding topics. However, the same plan of indicating the minimal ssentials for all and of assiging mate-

1 Francis D. Curtis, "A Synthesis and Evaluation of Subject-Matter Topics in General Science" (Boston: Ginn & Co., 1929)

rials to be mastered by the more capable ones, should be followed with the syllabus as with the single textbook.

Thus in the course of the year, while all the pupils will have covered and become familiar with the entire book or syllabus, they will have been required to master amounts varying with the teacher's estimate of their capabilities. All will have mastered the minimal essentials, but the average pupil will have mastered a considerable body of subject-matter in addition to these, while the brightest will have been kept working up to their capacities in mastering most of the contents of the course. urther provision for individual differences can be made at the same time through the assignment of special reports, problems, experiments and extra readings to correlate with the text materials.

This plan is, of course, essentially a modification of the contract plan; but it provides perhaps a more elastic adjustment of goals to specific capacities.

TESTING. At least two distinct kinds of tests are needed for measuring progress in general science: The first should aim to measure only the mastery of factual material; the second should test power, that is, reasoning and judgment—the ability to apply in problem situations the scientific facts and principles learned. The ability to reason from facts and principles, however, is a far more important product of the general science course than the mere possession of a knowledge of facts and principles. Yet the dullest pupils have practically reached the limits of their abilities when they have learned the facts; they can do little in the way of abstract reasoning from these facts.

A test over the minimal essentials for a group containing both very dull and very bright pupils should therefore have as its *core,* test items covering the essential facts all are expected to have learned. Every pupil should be expected to answer all of these items correctly. The remainder of the test should consist of items requiring the application of these facts and principles to problem situations. These power items should vary in difficulty from simple to relatively abstruse reasoning situations. The duller pupils will probably be able to score the correct responses on only a few of these power items but the brighter ones should reason out most of them. If the test be properly constructed, no pupil will score either zero percent or a hundred percent upon the section involving

reasoning; either score would indicate that the pupil had not been tested adequately, since, in the first case, the test had no items sufficiently simple to come within his ability to reason with the material, while in the second case the test had failed to measure the upper limits of his ability to deal abstractly with the materials.

Additional fact and power items should cover the text material beyond the minimal essentials; but since the amount of material beyond the essentials which has been studied for mastery varies with the different pupils, a wide variation in scores should be expected, both in the factual and the power items.

DIRECTED STUDY. It is a common observation among teachers of general science that pupils do not study effectively. Part of this difficulty can be laid to the inability of some of the pupils to read with facility and comprehension. There is little doubt that earlier textbooks contributed to this reading difficulty by including a vocabulary much too advanced for the majority of the pupils whom the book was intended to serve. The authors of recent textbooks in general science, influenced by the results of two outstanding investigations by Powers,[2-3] have used a relatively simple vocabulary.

Simplifying the vocabulary of the general science textbooks has greatly helped, but it has not solved this problem of study disabilities. Most of the pupils still fail to study effectively: The reason is in most cases that they do not know how to study because they have not been *taught* how to study. The general rules which have been formulated and widely disseminated as advice to pupils in establishing effective study habits have likewise failed to any considerable extent in solving the problem: A recent critical evaluation of a number of investigations of the study habits of pupils[4] revealed significant "discrepancies between precept and practice."

The solution of this problem of teaching pupils how to study, like all others in education, apparently lies not in giving the pupils generalized directions, valuable though these doubtless are, but in giving them training in specific tech-

2 S. R. Powers, "The Vocabularies of High School Science Text-books," Teachers College Record, XXVI (1925), 368-82
3 S. R. Powers, "A Vocabulary of Scientific Terms for High School Students," Teachers College Record, XXVIII, (1926), 220-245
4 Percival Symonds, "Methods of Investigation of Study Habits," School and Society, XXIV, (1926), 145-152

niques and skills. Recent research investigation, most notably one by Beauchamp,[5] indicate unmistakable values gained from teaching and drilling pupils in certain simple study techniques, which any teacher with a little practice can successfully impart to his pupils. Among the most practical of these techniques for directing study are: (1) teaching the pupils to skim through a paragraph or a unit for general orientation preceding intensive study of the materials; (2) teaching the pupils to look for and to mark in their books "guide-post sentences" (the topic sentence or the summary sentence, usually) in the paragraph; (3) teaching the pupil to summarize paragraphs briefly and to make summary paragraphs of sections; (4) teaching the pupils to split large topics and problems into smaller ones and then to attack the smaller units one at a time as a means of mastering the larger ones; (5) teaching the pupils to prepare questions of various sorts upon material which they read; (6) furnishing the pupil guide sheets in the form of conventional old-type questions and new-type test items the answers to which the pupils can find by studying the text.

All of these techniques will not serve all pupils equally well; but the pupil who has been taught *how* to study in all these ways is practically certain to find one or more of them especially effective for his own purposes.

LABORATORY WORK. At the beginning of this century the individual laboratory method was the prevailing practice in the secondary schools in which laboratory work was offered. When general science developed, about twenty years ago, it was natural that the individual laboratory method should be favored for this course; but the expense of equipment made this plan impracticable in all but the largest and most heavily endowed schools. Within the last ten years a number of studies, chiefly those of a group of investigators under the able direction of Dr. Elliot R. Downing, have shown that the demonstration method of laboratory work, in which the teacher performs the exercises before the pupils, imparts some sorts of knowledge and perhaps even some elementary skills better and more economically, both in time and money, than the individual method. A recently published dissertation by

5 Wilbur L. Beauchamp, "A Preliminary Experimental Study of Technique in the Mastery of Subject-Matter in Elementary Physical Science," Studies in Secondary Education I. Supplementary Educational Monographs, No. 24. (The University of Chicago Press, 1923) pp. 47-87

Horton,[6] however, presents evidence to show that, in the field of chemistry at least, the individual method contributes more largely than the demonstration method to the acquirement of manipulative skills and to problem solving through projects.

The results of these numerous research investigations would seem to indicate clearly that neither the individual nor the demonstration method of teaching laboratory work should be used exclusively in the general science class. Considering the immaturity of the pupils and the introductory nature of the course, it seems sensible that a majority of the laboratory exercises, especially those requiring expensive or complicated apparatus, should be performed as demonstrations by the teacher; and that a considerably smaller number, those requiring apparatus which is simple and easily provided, should be performed individually by the pupils. The pupils should be encouraged to perform, voluntarily and individually, additional experiments at home, and to work out projects to be recorded and subsequently reported upon before the class.

Individual pupils undoubtedly gain much by being allowed before and after class to play with and manipulate apparatus used in demonstrating experiments. The teacher needs to supervise these activities to prevent horseplay and to insure that the more selfish pupils do not appropriate the apparatus to the detriment of the more timid ones. It is to be expected, moreover, that some apparatus will be broken in the course of such free manipulation, but this breakage is not likely to be great. The individual values gained from such pupil activities, moreover, doubtless justify such incidental breakage.

LABORATORY REPORTS. The pupils should be required to make some sort of record of every experiment as soon as it has been completed, whether it has been performed by the pupil himself or by the teacher. Unless such a record is made, the experiment will subsequently be found to have served many of the pupils chiefly as "effortless entertainment." The types of record should probably vary considerably, depending upon the complexity of the experiment: In some cases a brief statement or paragraph accompanied by a rough diagram will suffice; in others, a complete and formal record may seem

6 Ralph E. Horton, "Measurable Outcomes of Individual Laboratory Work in High School Chemistry" (New York: Bureau of Publications, Teachers College, 1928)

desirable. A recent study by Stubbs[7] showed that the method of filling blanks gave results only slightly inferior to those secured from writing up a complete and formal report, but with a great saving of time over the formal method. The recently reported "moving picture" method[8] of recording experiments, in which the pupils substitute a series of labeled diagrams for the conventional description of manipulations and observations, showed slight superiorities over the formal method, especially with respect to economy of time.

The successful teacher of general science will probably find that he secures best results with the laboratory reports if he uses as wide a variety of methods of reporting exercises as possible. After the pupils have mastered the technique of reporting by the formal essay method and the "moving picture" method, it will frequently be found advisable to allow them to decide for themselves the type of report they wish to use, and to give full rein to their individual capacities for expressing what they have observed. The teacher passes among the pupils as they work, correcting individual errors in English, and pointing out deficiencies or inaccuracies of observation. The able pupils who finish first, can be stimulated to apply in problem situations the scientific principles learned from the experiment.

QUESTIONING. Skilful questioning is an art which too few teachers possess but which all may acquire. The average teacher of general science probably uses only a few types of questions, chiefly these involving observation or pure memory. Such questions are well adapted to the less able members of the class but if the individual capacities of the pupils are to be developed maximally, a wide variety of questions, demanding reasoning and judgment and developing the scientific attitudes, must be introduced. In an analysis of textbooks and laboratory manuals of general science Cunningham[9] found twenty-two distinct types of question appropriate to the general science course. The teacher of general science should be familiar with all these types and should master

7 Morris F. Stubbs, "An Experimental Study of the Methods for Recording Laboratory Notes in High School Chemistry," School Science and Mathematics XXVI (1926), 233-239

8 Fred W. Moore, Claude J. Dykhouse and Francis D. Curtis, "A Study of the Relative Effectiveness of Two Methods of Reporting Laboratory Exercises in General Science," Science Education, XIII (1929), 229-235

9 Harry A. Cunningham, "Types of Thought Questions in General Science Textbooks and Laboratory Manuals," General Science Quarterly, IX (1925), 91-92

the technique of formulating and using a considerable number of them in his daily class work. The relatively recent introduction of new-type tests gives the teacher a valuable means of varying the types of question still further, by substituting true-false, completion, multiple-response, matching, and other forms for the conventional form of question. The pupils should be encouraged to formulate questions for the other members of the class to answer; moreover, they easily learn the technique of making simple new-type test items and enjoy using these along with the conventional types of questions.

The Contract Plan in General Science

EDITH WARE BRADLEY

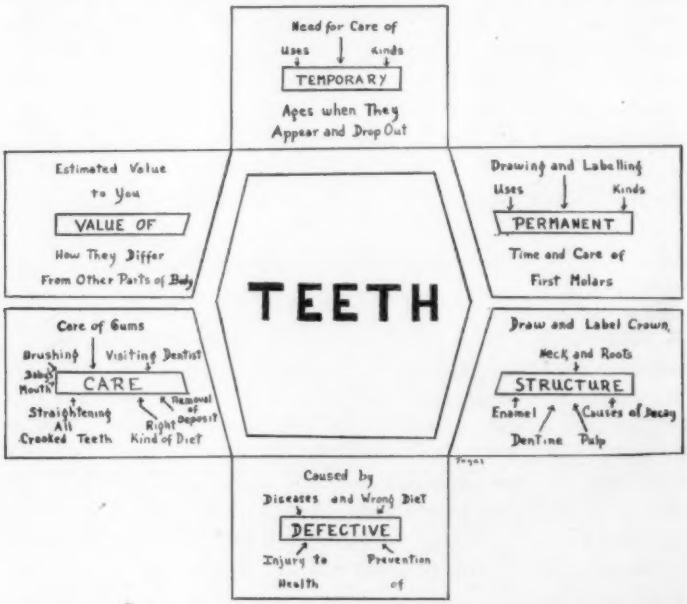
Lakeview Junior High School, Oakland, California

The contract plan has often been used by many teachers in various subjects. Perhaps it has not been called the "contract plan," but the principles involved have undoubtedly been the same. However, it is certainly not a stereotyped form of teaching; the best definition which I have found for it is "a means of releasing potentiality in wholesome ways for every boy and girl," by Harry Lloyd Miller in his book, "Creative Learning and Teaching." Mr. Miller also says, ". . . the Contract Plan will become precisely what we make it." Keeping this last statement and the definition of it in mind, think what we can make it!

I have observed and used the plan in teaching general science both in Denver, Colorado, and Oakland, California, with results which are most gratifying to both teachers and students. However, no two teachers have used exactly the same plan as it "bends" itself to meet the needs of the individual student, and cannot therefore be stereotyped. At present, I am using a form which Miss Dorothy Osburn contrived and find it very satisfactory. It is interesting to note that although we teach in the same building, using the same form, attaining the same objectives, we "bend" the plan for our own interpretations and students, so that we do not use it in the same way. "No two schools should be expected to produce identical patterns."

I shall explain my procedure in the High 7 work which includes the study of Body and Health. First, I divided the

course of study into units, using each unit as a basis for a contract which I tried not to make too simple. This picture



showing the contract on the study of teeth is similar to all contracts used. It is made so that any student may start on any part of it as he wishes. Mimeographed sheets of the contracts are made so that the children may paste them into their notebooks and that time may be saved on dictation and board work. Each student is given a contract after which a detailed explanation of the plan is given. An informal discussion takes place concerning each division and subdivision on the contract. Questions naturally arise concerning the form of the notebooks, the amount of material expected on each topic, etc. This leads naturally to the problem of how to study.

I find that keeping in mind Morrison's seven points on the ability to study, from his book "The Practice of Teaching in the Secondary Schools," a very excellent help in teaching the children at this point of my plan how to study. The seven points are: (1) reading understandingly, (2) writing legibly, (3) using reference material intelligently, (4) organizing sub-

ject material logically, (5) expressing one's self clearly and correctly, both orally and in writing, (6) sensing the spirit of literature and art, (7) maintaining sustained application. I let the class decide just what topic they would like to take first, and together we go through all available material on that subject. I jot down on the board in outline form, or in brief, the "meat" of all summaries, aiming to teach the child to organize his material logically and to sift out the real facts. The idea is to write legibly in the notebooks the important facts which they have read understandingly — "to master central ideas and not be lost in the mire of performance."

Each child then begins his own task in his own way, keeping in mind suggestions made under the supervised study. The minute the class arrives each one then begins work without a word from anyone; there are no idlers; each one has a definite worth-while task in mind. A class at work under such a plan is indeed a class at work. Practically everyone is interested in doing his best in this worth-while task and comes nearer to working up to capacity than in any other plan I have ever used or have seen used. The place of the teacher is to help over the "rough spots." Our principal, Mr. Edgar Müller, once said that the place of the teacher is to help the student at that particular point where the latter can go no further. This is exactly the procedure of the plan — the teacher is a guide, in the background, but "on the job," encouraging, guiding, supervising. Students are urged to bring unfamiliar passages for discussion and if the student receives willing and encouraging help the results are far superior and the child less apt to copy into the notebook some passage which he does not understand. The teacher has more time to give to the one who really needs it and if this help is given kindly with encouragement, the slower student will do far more.

The science library in the science room is indispensable in the contract plan, as no one book ever covers entirely the unit studied. However, I find that the ideal situation is to have each child using a good textbook, and also have in the science room a good library of several copies each of the best science books, as well as government bulletins and usable pamphlets put out by commercial firms. Such a library offers excellent opportunity for training in the use of a variety of books. At the beginning of the course, instruction is given in how to

use the books,—and the searching really begins in a science library. The child is encouraged to look up material on a subject in several books, to compare authors, and to learn to use a variety of references. It is interesting to note that more books are *used,* both at home and in the science library, than ever before.

The next question which arises is the time element. How much time should be given for each contract? When I first used the plan, I set a definite time limit, but did not find that as satisfactory as the plan which I use at present. When the work is started and well under way, a teacher can "sense" the time for completion by observing the "speed" of the class. The time limit can then be stated, so that those who are slow may know far enough in advance and, if necessary, do some home work. My experience has been that there are few loiterers and even they may be encouraged to do their best with wise and sympathetic guidance. Therefore the time limit can be satisfactorily made after the class starts. However, I announce the number of contracts which are to be completed before the term is over. I once told a superior group that the sooner the contracts were done the more time we would have for experiments. This proved fatal for so many took work home and worked so hard that parents objected (when no home work had been assigned). Therefore each teacher can "sense" the situation and arrange it to meet his or her own needs.

There will always be students who finish the minimum requirements before the group, so that the plan may take care of the fair, good, and excellent workers by arranging further work for those who can go beyond the fair and good. At first, I suggested that those who finished early might have the privilege of going to the library and reading topics which were of interest in science. This proved satisfactory for only a short time as the student came back ready to take up something definite and interesting to him. I have several suggestions to make here. First, I have a set of extra contracts of things of interest to different pupils; I find out the thing which interests the child most in science, and let him work on that. For example, I learned that one student was interested in microscopic study; so I arranged the microscope and a contract on the same for her use. I also have suggestions for

posters, cartoons for the school paper, reports, talks, plays, stories, compositions, etc. This gives the student an opportunity to work on the things in which he is most interested. Quite often, I find the better sections can complete an extra contract beyond the work of the slower sections. I do find, however, that there must be definite work planned for the good and excellent workers or they will waste time which can be used very advantageously.

When the time limit is up, then begins group discussion and experiments on the contract. This is not in the form of a dry recitation; it is an interesting discussion by the pupils on new things discovered. Here the child learns to review reference material and to use his own notes intelligently. In some units I have suggested that notes be written not in outline or brief note form but in story, or some other interesting form. This has brought interesting "returns" for the discussion. Occasionally, I ask the class to work in groups and present the material for discussion in some unique way (suggesting contests on questions and answers, experiments, plays, poems, cartoons, compositions, stories, etc.). After group discussion, I sum up the most important points, review them with the children, and then give a test on the same. Various types of tests may be used.

The next question which comes to mind is, "What are the results?" Teachers are enthusiastic. I have never seen one who used the plan and who did not prefer it to other methods. Objectives are obtained which are not even touched in other plans. But are the children enthusiastic? In order to answer this question from the student's point of view, I presented a questionnaire to them, in which I asked the following questions:

> **Do you like the contract plan of working?**
> **If so, why?**
> **If not, why?**
> **If you have no points for or against, just say you are neutral.**
> **Which do you like better—recitation or contract plan? Why?**

I asked them not to put their names on the questionnaires. The results were: 135 students voting; 108 stated reasons for liking the plan; 18 against; 5 neutral; 4 pro and co.n I did not influence their vote in any way, which is shown by the fact that several asked me if I liked it, when they received

the questionnaire. However, I reserved my answer until all students' answers had been turned in.

I collected and put in the child's own words as near as possible the reasons given by them for liking the plan. These reasons and the number who gave them are as follows:

1. Industrious student has a chance to get ahead—not wait for others who can't work as fast. (46)
2. Prefer contract plan to recitation plan for following reasons: (1) easier to look up own information and get much more out of it than trying to take notes or remember what someone else has said; (2) can't hear half that's recited; (3) half of the class never listen to speeches—rather pass notes or think of something else; (4) never get anything out of a lot of "rig-a-ma-role" someone else is talking about; (5) can get better material yourself than try to listen to someone else; (6) talks and reports are dry and uninteresting; (7) get things all mixed up" in recitations; (8) in recitations, students talk just because they have to, not because they are interested or want to; (9) tiresome to have to get a lesson and recite it every day; (10) contracts a lot more fun than reciting; (11) talks go in one ear and out the other in recitations. (33)
3. Better chance to do your best, and get good marks. (32)
4. Can work at home on science when you want to; if rushed with other home work can do science work other nights. Also seldom have home work to do, unless you want to, if you work hard enough during class period. (22)
5. Very definite—know what you are doing—no confusion—know what is expected of you—balanced—nice to know what you'rs going to study several days before hand—understand what you're doing. (20)
6. Learn more for following reasons: (1) have to hunt it yourself; (2) have to concentrate when looking up your notes, and think more; (3) easier to learn and remember when read first and then written down; (4) know it after you have finished. (20)
7. More interesting for the following reasons: (1) get more out of it; (2) to write it down and then have interesting discussion on it after you've finished; (3) good feeling to do school work and take an interest in it; (4) because you have something definite to do. (18)
8. Don't miss so much if you have been absent, as you have a definite contract to work on and make up your work. (12)
9. No time lost as in recitations—get busy without waiting for anyone—come in, sit down, get busy—keeps you busy, and makes period pass more quickly, as you are concentrating on your work ("mind isn't wandering as when you sit listening to recitations")—keeps you busy instead of talking and passing notes—"can't lay down on the job"—don't "fiddle away time." (9)
10. Teaches child to do things for himself; gives chance to work alone; study better for yourself the things assigned; gives more of an idea what science is when you work for it yourself. (7)
11. "Don't have to rush like a centipede," but just keep going—get more out of it because have time to think. (7)
12. More fun for following reasons: (1) in keeping a neat and attractive note book; (2) easier; (3) can look up for yourself; (4) don't have to prepare a lot of talks and reports all the time. (5)

13. Don't have to prepare a lot of speeches. (5)
14. Quicker. (3)
15. Use notebooks for reference. (5)
16. Can compare authors when looking in different books for same topic. (2)
17. Like the science library in the contract plan. (2)
18. Chance to study science more—"advances you more in science." (2)
19. Don't have to sit still all period; can get books down from science library as need them. (1)
20. Not so many tests. (1)
21. Can work steadier. (1)
22. Helps in spelling new words. (1)
23. Don't get tired of it. (1)
24. "Helps to raise self-control." (1)
25. Makes one "feel more advanced." (1)
26. More valuable. (1)

The reasons given in favor of the plan speak for themselves. They are objectives which are really attained and which even the pupil appreciates. Not only the pupil and teacher recognize the excellent results in realizing so many worthwhile objectives, but substitute teachers, parents, and principals also see the advantages.

Next, with regard to the reasons given for disliking the plan, it is worth while to consider each one, to see whether or not the plan is at fault. The reasons, and the number giving them, are as follows:

1. Write too much—rather talk—can express self better in daily recitations than in writing—don't see any advantage in writing information down (suggestion is made, "why not read it all through and then take test on it to see if we know it")—recitations help you to learn better. (7)
2. Not enough time to complete the contract. (6)
3. Can't understand some things—have to re-study it because don't understand some things written down. (6)
4. Must do home work to finish. (3)
5. Too much trouble—too much work—takes extra work. (3)
6. Can't write fast and well, therefore don't have chance to do best and others get ahead. (2)
7. Don't like others to get ahead—would rather have all work together. so faster ones couldn't get ahead. (2)
8. Too dry when you have to look it up for yourself. (1)
9. Have to get things out of books. (1)
10. Don't like it but think it is the best way.,(1) (Evidently the lesser of two evils.)

In regard to the first reason, I failed to "put over" my idea to those students in the group study at first, or I am sure they would organize their work better and not have so much writing. The second and fourth reasons, of course, mean that the very slow student needs more time. I do feel that more individual attention on my part in those cases might have corrected that. Again, I failed in the third case, as I did not

encourage those particular students to discuss difficult parts with me. The fifth, eighth, and ninth reasons sound like those of lazy individuals who might "object to work." The sixth is evidently no fault of the plan, and the seventh objects to one of the very things that make it a good plan.

Consideration of the answers to the questionnaire as expressed by the students shows that the majority are very much in favor of the Contract Plan and that even those who are not in favor could probably be interested through the efforts of the teacher. From my own experience, from observation of students in other classes, working under this plan and others, and from talks with teachers of science as well as other subjects, I am more than convinced of the practical value of the Contract Plan and recommend it very highly.

THE SALTON SEA, CALIFORNIA

During 1907 heroic measures finally stopped the overflow of the Colorado River into Imperial Valley, California, but not until a lake, known as Salton Sea, had been formed covering 330,000 acres to a maximum depth of 79 feet, containing enough water to cover 16,000,000 acres to a depth of 1 foot. As the surface of this lake was 194 feet below sea level, there was no place to which the water could drain, and were it not for nature's pump—evaporation—the lake would probably be nearly the same today as it was in 1907. As a result of evaporation, however, the lake receded until by 1920 it covered only 170,000 acres. Since 1920 the lake has been fairly stable, due to inflow of natural drainage and a large volume of seepage and waste water from irrigated lands in Imperial Valley, but what of the future? A report has recently been prepared by George F. Holbrook, an assistant engineer of the Geological Survey, which contains a brief history of Salton Sea, describes the conditions which surround the lake, and concludes that in order to evaporate the amount of water that may be wasted into Salton Sea under conditions of ultimate irrigation development, an average water-surface area of 239,000 acres will be necessary.

Measured Outcomes of Laboratory Instruction[1]

Ralph E. Horton,
Seward Park High School, New York, N. Y.

The Experimental Program

This program, involving seventeen chemistry sections and over six hundred students was inaugurated in the spring of 1927 in the Seward Park High School. From these sections nine experimental groups with a definite variable in laboratory procedure for each group were set up. Seven teachers were involved and pupils from several teachers were included in each group so as to make this factor practically constant. The groups were, first of all a random sampling of the registration in chemistry. Since the plan was to use the Equivalent-groups Method, the groups were equated on the basis of a written test in chemistry given as a regular examination in the school. The examination was very carefully prepared; was entirely objective; was validated by reference to the course of study and by the judgment of seven teachers of chemistry who were the final arbiters of criterions for passing and failing in this subject. Its Index of Reliability arrived at by the method of correlation of pupils' scores on odd and even numbered questions proved to be .94. On the basis of the scores in this test, the group were so constituted that their Mean Scores and Standard Deviations were approximately equal. This made them statistically equivalent. The control group or group of reference consisted of four sections instructed by four teachers and numbered, on the equated basis, 128 pupils. All groups were instructed for five periods of fifty minutes each, per week. These weekly periods, for the control group, consisted of one individual laboratory exercise in which pupils followed mimeographed directions from a manual; one period of formal teacher demonstration; and three recitation periods in which textbook study, lecture, discussion and written work all formed a part. The other groups each had a single variable, namely, the method of laboratory instruction. On four days per week all classes had the same kind of work which followed a weekly schedule and was supervised to keep it as uniform as it ought to be by the chairman of the department.

1 Continued from page 319, Science Education for November, 1929.

Only two of these groups concern this report. These were both instructed by the problem method. One group was composed of 29 pupils and had instruction by this method for twenty weeks. The other consisting of 63 pupils in two classes was instructed by the same method by different teachers for ten weeks. These groups and the control were examined by four forms of test: (1) A Written Test of Information; (2) A Written Test of Chemical Judgment; (3) A Group Test of Ability to Manipulate Apparatus; (4) A Group Test of Ability to Perform Projects in the Laboratory. The results of these tests are summarized in Tables V and VI.

TABLE V

Mean Scores of the Groups for Each Test

Name of Test	Control	Probs. 20 wks.	Probs. 10 wks.
Written Exam.	41.08	42.21	41.84
Chem. Judgment	11.28	13.35	12.72
Apparatus	3.69	8.27	9.04
Chem. Projects	6.07	13.67	8.75

TABLE VI

Differences between Mean Scores — with Reliabilities. The differences in all cases represent the number of score points by which the Mean Score of the Experimental Group exceeds the Mean Score of the Control Group.

Test	Group	Difference	S. D. of D.	Diff. / S. D. D.
Written Exam.	Problems 20 wks.	1.13	1.39	.81
Written Exam.	Problems 10 wks.	.76	1.00	.76
Chem. Judgment	Problems 20 wks.	2.07	.66	3.14
Chem. Judgment	Problems 10 wks.	1.44	.55	2.62
Apparatus Sets	Problems 20 wks.	4.58	.32	14.50
Apparatus Sets	Problems 10 wks.	5.35	.37	14.42
Chem. Projects	Problems 20 wks.	7.60	.67	12.30
Chem. Projects	Problems 10 wks.	2.68	.46	5.83

Note: The measure in the last column $\frac{\text{Diff.}}{\text{S. D. D.}}$ represents the probability of the true difference being in the same direction. In a normal distribution, practically all the cases would fall $\pm$ 3 sigma distance from the Mean. Hence when a difference is 3 times the S. D. of that difference, it represents "Practical Certainty." Values greater than 3 are correspondingly more reliable.

The differences shown are so great and the reliability so consistently high in the performance tests, that with the verification afforded by the ten and twenty weeks groups as well as by the two distinct tests which demand much the same sort of ability, it seemed safe to infer that the method yielding such outcomes must be a superior training for doing the kind of task demanded by these tests. These can now be briefly described.

The performance test labelled, Test of Ability to Make Apparatus Set-ups consisted of 10 problems, in each of which the apparatus was to be set up to prepare a described substance from other substances whose properties were given but whose names were not given. The following tasks were proposed: "Set up the apparatus for doing each of the following laboratory jobs":

1. To prepare a gas formed by heating solids which must be mixed together. The gas is soluble in water and heavier than air.
2. To prepare an insoluble gas formed by mixing without heat a liquid and a solid. The gas is lighter than air.
3. To prepare a gas formed by mixing without heat a solid and a liquid. The gas is soluble and heavier than air.
4. To prepare a gas soluble in water and formed by heating a mixture of two solids. The gas is lighter than air.
5. To separate a soluble substance dissolved in water so that you get quickly a fine powder.
6. To separate a soluble solid from solution in water. Get the solid in the form of crystals.
7. To separate an insoluble solid from a mixture with water and dissolved substances.
8. To separate one liquid from a mixture with other liquids. The liquids have different boiling points.
9. To set up an apparatus to test the solubility of a gas in water.
10. To prepare a liquid whose boiling point is 80 degrees Centigrade but which is formed by the action of a solid and a liquid whoes boiling point is 338 degrees Centigrade.

The technic of administering this test was the same as for the group tests previously described. Each individual pupil was supplied with complete equipment of apparatus. Four proctors (teachers) assisted. Each pupil was given a mimeographed sheet with the list of problems as just proposed. At a signal all commenced work. As soon as a pupil completed one task he raised his hand. A proctor inspected the apparatus, compared it to a key (a set of sketches adopted to secure uniformity of rating), and marked the item right or wrong beside his initials on the test paper. Forty minutes were allowed for the test. From the collected scoring sheets the statistical measures were calculated for the classes.

The "Laboratory Projects Test" was very similar in administration. Its tasks were a bit different, however. Two problems were given, with sixteen objective items for scoring. In this test the task was to actually prepare and identify the substance whereas in the former test only the apparatus was to be set up. One problem was, "Prepare and test a gas which can be made by heating in dry form the powders in bottles labelled I and II. The gas is very soluble in water and is lighter than air." Neither the names of the substances used nor to be prepared were given to the students and no student had any acquaintance by discussion or observation with the proposed preparations. This avoided memorization. The problem consisted, therefore, of selecting from the students' experience a suitable pattern of apparatus from a mental image of it. This apparatus must meet the requirements and be reported to the proctors in steps which were listed on the direction sheet. Ability by the student to manipulate the apparatus, to actually make the preparation and to show a sample were required. The index of reliability of this test proved to be .95. This index is higher than that for the Apparatus Test, for the reason, presumably, that a larger number of items were scored.

From this description, then it can be seen that these tests were designed to detect differences resulting from different methods of laboratory work. That they did detect differences which are not disclosed by the written test also seems apparent from the tables of results just exhibited. We may now ask, "Is this kind of task the sort of thing we want pupils in chemistry to be able to do? Are the abilities measured worth while and of probable usefulness in further science study or in other activities of life? To the first question we can say that the tasks are precisely the things we do ask pupils to do; and they are typical of the kind of task that will be asked of them in further laboratory study of chemistry. But the extent to which these abilities will spread to other fields of thought or action cannot be inferred from these data. If problem solving and ability to do tasks in the laboratory are important, practice in doing similar tasks in the laboratory by self-direction seems to attain this end best — or at least is one way to do it. This practice we have called the Problem Method."

In just a few words I will outline this proposal as we have adapted it for use with large classes and for single laboratory periods of fifty minutes. Each day's laboratory work is proposed as a problem arising from the topic for the week. The pupils follow a formal procedure which conforms to the five formal steps in logical thinking and is in their hands as a mimeographed sheet, a copy of which appears below. Before coming to the laboratory, each pupil studies the problem in the light of his experience and makes a written plan. *First,* he is to make a guess or hypothesis as to the answer. *Second,* he is to devise and write out a detailed method of experimentation to verify or disprove this guess. *Third,* he is to make a sketch of the apparatus he proposes to use.

SEWARD PARK HIGH SCHOOL
NEW YORK CITY

DEPARTMENT OF SCIENCE

Record of Laboratory Work. Name.....
Science Class..... Date.....
SUBJECT (Name of Topic).....

PROBLEM: State your own perplexity in the form of one or more precise, simply worded questions.

HYPOTHESIS (guess): Briefly state one or more possible answers that occur to you after thinking the questions over. If you have more than one question in your analysis of the problem, indicate your guess for the answer to each.

SKETCH: Make a sketch of the apparatus as you propose to set it up in your experiment. Do not invent apparatus. Make use of forms you have seen used in demonstrations.

EXPERIMENTATION: Devise (i.e. make up) an experiment in which you state definitely just what you propose to do to test out your hypotheses. Number each step of your method. Write up this plan at home before coming to the laboratory.

In the laboratory, when your book is approved, do those things you have outlined in your method and record what happens, together with any measurements, in a column headed Observations.

SUMMARY:

1. Decide by inspection of the facts whether any one of your hypotheses was correct. If you think it was state the answer to the question.
2. If the evidence was against your hypothesis, state this as the answer to the question.
3. Next—if your hypothesis was wrong—look at the question and the facts and make another guess; try this plan on another page and with another experiment, if necessary.
4. Finally, make one or more statements of what use your conclusion is; or what other questions it suggests.

This plan is submitted to the instructor as the pupils file past him with their notebooks open. The sketch, hypothesis and plan can be noted at a glance. If it appears safe, the pupil goes to the supply table and gets his apparatus, proceeds to his own bench, sets up the apparatus, makes the

experimentation and records his own observations. When complete, he makes a summary and conclusion as to the truth or falsity of his original guess. No attempt to get uniformity is made. On the contrary, plans which will result in a wrong answer are quite as acceptable, for it is just as important for pupils to find they are wrong, providing they decide on the basis of facts and admit their error when faced with the facts.

The method of scientific thinking is made conscious to the pupils as the habit to be acquired and the laboratory period as the place and time to practice its use. All phenomena of chemistry necessary for information and for success in written tests is presented by teacher demonstration. Likewise all manipulative technics are presented as model performances by the teacher with the expectation that the pupils will make use of the information so obtained to solve the problems assigned. From the start, emphasis is placed upon the aim of acquiring the habit of attacking problems in a scientific fashion and of making the best guess they can from their fund of experiences but to not rely on this guess unless experimental evidence bears it out.

This plan, as you can see, differs from the "project method" as usually conceived in several particulars.

First. The aim is not lost sight of in the method.
Second. Class groups remain intact.
Third. The organization of subject matter of the chemistry syllabus is retained.
Fourth. The sequence of weekly topics is not disturbed.
Fifth. All pupils in the class attack the same problem but the hypotheses and methods of experimentation are devised by each pupil individually. Thinking is consciously made a goal and is required *before* the laboratory exercise in planning the experiment and *afterward* in making conclusions from the facts.
Sixth. The regular laboratory period is utilized for the individual experimentation.
Seventh. No written or oral instructions are given to pupils for the laboratory work; instead, each pupil devises his own experiment to test his own hypotheses.
Eighth. The technics for setting up apparatus are learned by watching the instructor in preceding demonstrations.
Ninth. Generalization of "patterns" of apparatus for general purposes rather than for specific substances is made consciously by both teacher and pupils. This is in contrast to the common method of learning an apparatus as a part of a specific experiment.
Tenth. The problems themselves are not artificial but arise in the regular course of chemistry and are broken up when necessary into units capable of being attacked experimentally in one laboratory periods of fifty minutes. Investigations requiring longer time are encouraged and lead to after-school, individual projects.

One of the very practical aspects of the plan is that of doing away with the traditional practice of following directions. This practice seems to be poor psychology and defeats one chief aim of education, namely, the training of men and women who are self-directive and resourceful. Bulletin No. 26 says, "In the laboratory directions are often followed blindly and meaningless results obtained." This is stating the case mildly. No doubt the ability to read printed directions and to follow these directions with care must be acquired by anyone who proposes to do scientific work. Yet what can be expected from following directions is, at the best, the ability to follow more directions. No objective evidence has been reported to show that the following of directions from a manual, nor the copying of voluminous descriptions, does give returns in terms of success in chemistry when measured by written tests, or by any other measure. On the other hand, the data in this study seem to indicate some advantages for laboratory work planned by the individual pupil himself.

The purpose of this paper was to present some ways of testing abilities developed by individual laboratory work in an objective way, to point out that these abilities were of a manipulative nature which exhibited themselves in *doing* rather than telling; and to submit an experimentally tested plan of using these measured possibilities of the laboratory work for training in the scientific method. Your criticism of these proposals is invited.

NICKEL CHROME ALLOYS.

Many alloys of this stainless family have additions of nickel which aid their resistance to oxidation for many purposes, though nickel renders their cutting with tools, i. e., machining, more difficult, and forging is less easy. Some very useful alloys have 15% to 20% chromium with from 1% to 60% nickel. One well-known one is the 80% nickel–20% chrome composition from which the wire of toasters, electric irons, hot-plates, and other household appliances are made. Another is the 8% nickel–18% chrome–74% iron alloy from which sulphur-resistant tubes are made for oil-refining stills, steam boilers and superheaters, paper-mill digesters, and other chemical resistant apparatus. There are hundreds of other such alloys.

The stainless steels and irons are playing a very important role in our life today.

The Coordination of Nature Study Activities, with Emphasis on Public Cooperation[1]

A. B. Brooks,
Park Naturalist, Oglebay Park, Wheeling, W. Va.

A citizen of Wheeling, West Virginia, recently said to me: "Our city and community have finally found a common interest, something which lies apart from industry and gaining a livelihood, something which is unselfish, and in which all can unite without any distinctions being drawn." His reference in this statement was to Oglebay Park, a 750-acre area of woodlands, planted grounds, and fields of blue grass, lying on the hills that overlook the Ohio River, and bequeathed to the city referred to by the late Colonel E. W. Oglebay for educational and recreational purposes.

The object of this paper and the illustrations which follow are to show how nature study in a city park, in the space of two years, may become a part of the life of a community, correlating with a great variety of its activities and interests and furnishing an outlet for the expression of its finest and best desires.

Twenty-four months ago the problem was how to convert this estate with sixty-eight buildings, including greenhouses, machine shops, dwellings, stock barns, and other elaborate farm equipment, into a park which would conform to the wishes of the liberal donor and meet the needs of the people to whom it had been given. One possible type of conversion was to install a number of amusement devices, fence off an area among the shade trees for a menagerie, plant more formal gardens, build more roads, and invite the public to come in and take possession. Fortunately the decision rested with those who wished to make a departure from the rule and undertake a project which would add to the recreation ordinarily furnished by a park an appreciation and deep enjoyment of its natural advantages. Accordingly the Oglebay Estate, through an endowment and a thoughtful leadership, together with the Extension Division of the West Virginia University, joined

1 Read at a meeting of The American Nature Study Society, Des Moines, Dec. 27, 1929. The Oglebay Park motion pictures were run following the paper.

hands with the Wheeling Park Commission to carry forward this undertaking. The plans having been laid, it was not long until an office building was re-furnished and placed at the disposal of a staff composed of specialists in out-door recreation, camping, sylviculture, floriculture, art, and nature lore; the mansion house was made into a museum of natural history; the club house into an auditorium; the carriage house into a little theatre; the immense dairy barn into a camping center; the sheep barn into a picnic pavilion; and the hackney barn into the headquarters of a saddle club. Curving about through the deep wooded gorges and by the streams and waterfalls, eight miles of nature trails were built, and in numerous places picnic sites were selected, each one isolated from the others and each having its fireplace, table and seats. The greenhouses were put to work growing plants for public grounds, and large areas were stocked with young trees for the future planting of an arboretum and demonstration forest plots.

The nature study program has already passed through several successive stages of development. The first nature walk in which the public was invited to join was patronized by four persons. The interest in this activity has increased until it has become difficult to handle the groups. The average number attending these field trips during the past summer and fall was one hundred and five. The largest number to attend an early Sunday morning bird walk was one hundred and eighty. The natural history museum, which occupies rooms in the mansion, is to be moved into more commodious quarters, the large horse barn unit having been designated for this purpose in a recent re-arrangement scheme. The first nature leaders' training school, held in 1928, was followed by one in 1929 with twice the enrollment. The call for information on nature subjects has doubled, and the requests for lectures by members of the staff have been more than could be met. To the beginnings of nature study have been added a project to carry on a complete biological and geological survey of the park area. Most important of all was the beginning of coöperation with the public schools of the city and surrounding section. Under the plan worked out the park has become a part of the public school. During the warmer weather of the school year, in spring and fall, pupils and their teachers are transported by bus to the Park, where the day is spent along the trails and

upon the grounds, learning to know and to love the green hills and all the forms of life which are met with in this richly-endowed sanctuary. The teachers, many of whom are well-trained in this field, are able to correlate many of the regular branches with nature study, thus enlivening them with an interest hitherto impossible. During winter months the Park staff carries its work into the schools, through illustrated talks on nature before assemblies, through aiding in establishing nature rooms or nature corners, and through visual instruction in the classrooms.

Without the most positive public coöperation the nature study activities referred to, and others which I cannot mention in so brief a paper, could not have been carried on. I desire to emphasize this feature of our work, which could be made a long story. But I will emphasize it through brevity. A Nature Association was formed for the specific purpose of backing the nature activities centering at Oglebay Park. This organization has a substantial membership and is constantly active. It contributes money and time. An Activities Committee, made up of sixty-four of the community's leading civic, educational, religious, fraternal, and other organizations, was organized to support the Park program in all its features. This organization meets monthly. Volunteer service has been generously given by the U. S. Biological Survey, the West Virginia Geological Survey, Bethany College, West Virginia University, Carnegie Museum of Pittsburgh, Cleveland Museum of Natural History, Cleveland Museum of Art, West Virginia Game, Fish and Forestry Commission, the Department of Ornithology of Pennsylvania, local Boy Scouts, Girl Scouts, public schools, and numerous others. Perhaps the most significant thing about the Park program for 1929 is the fact that nearly a thousand different people gave volunteer service. Many of these served as committee members, while others brought exhibits for the museum, acted as guides, volunteer nature and camp instructors, or contributed some feature to the music, outdoor dramatic, or nature lecture programs.

A total of 110,563 persons visited the park during the past season, all of whom were thrown directly in contact with the program, and most of whom, in one way or another, indulged in nature study or nature appreciation.

The articulation of nature study with the life and interests of the entire community is direct and vital:

The farmers' wives, in their organization, visit the Park and camp for a week, taking back home with them a lot of sunshine and renewed vigor, and a new outlook on life.

The children of the schools find that learning is not all in books.

The Boy Scouts, Girl Scouts and Campfire Girls, the Hi-Ys, the Girl Reserves, the King's Daughters, the Four-H Clubs, and numerous other young peoples' organizations, find here such opportunity for work and play as exactly meets the requirements of their growth.

Civic and fraternal organizations, in their day's outing, play games in a wonderful background of nature, and follow the lure of wooded trails.

Religious groups conduct vespers out under the blue sky and the trees, where the birds and the wind join in their songs and praises to the "God of the Open Air."

The lovers of music, of drama, and of art find here in nature's setting the inspiration for their highest expressions.

Men and women, boys and girls, from near and far, in storm or sunshine, follow the trails together.

In conclusion I want to add that the people of the present day long for the peace and quiet which nature alone affords. They want to know more about the things of nature, but their chief desire is to live closer and more sympathetically with nature. Parents and teachers see in nature study a fundamental part of education, but they see a greater value to the youth in these contacts—the growth of the germ of good citizenship and the building of character. Any nature study project that does not take into account this fundamental desire and need will be unable to accomplish the most important types of coöperation, and will not receive and does not deserve full public support.

How Can Various Nature Activities in a Community Be Articulated?

O. J. Hitchcock,
President, First National Bank, Havelock, Nebraska.

To answer this question I wish to present a brief resumé of a plan that has worked successfully.

The interest in our Nature Study Club had been waning for some time. Its membership was gradually falling away. Realizing that something must be done in order to maintain the membership, we decided this could best be brought about by making our community more "nature-minded." With this thought in mind, the possibility of interesting our entire community in some nature project—bird, flower, or tree study—was considered. Bird study was finally agreed upon, with the slogan: "Help our feathered neighbors while helping our Nature Study Club."

Our first aim was to secure the support of the various civic organizations and the help of public-spirited citizens in our locality, a thing that is essential in an undertaking of this

kind. We got together the presidents of the Lions' Club, Woman's Club. Parent-Teachers Association, leaders of the Boy Scouts and Campfire Girls, the school superintendent, city librarian, and two newspaper men. Our plan was explained to this group of people, with emphasis on the benefits that would inure to our community.

In order to select a representative from each organization who would be an enthusiastic supporter of our scheme, a survey of the membership of each was made. These representatives were selected without any difficulty, and we thus started with a group of persons in sympathy with our project. Definite plans were made and each representative was given the responsibility of getting these plans across to his group. Judging from the support of these various groups, the representatives did a good job of it.

Soon after the interest of the various organizations had been assured, the newspaper men came into action, giving out not only information concerning our bird study plan, but also information concerning nature subjects in general. Incidentally, if you wish to arouse the interest of the public in any enterprise, just get two live newspaper men in competition on the subject. We were certainly indebted to these men for their part in exciting interest in our scheme, and in keeping that interest alive.

We were fortunate in having a school superintendent who was interested in nature study. He not only welcomed our suggestions to bring bird study into the schools, but contributed widely in this direction. Springtime found the manual training department humming merrily in turning out bird houses, feeders, and best of all, enthusiastic builders and bird lovers. The teachers were interesting their pupils in birds by the use of Dr. Palmer's Bird Outlines, which show how the bill, tail, feet, and wings of birds are adapted to their mode of living.

At this time of the year naturally the leaders of boy scouts and campfire girls were taking up in their meetings the subject of "Birds and Bird Migration." Outlines for the taking of a bird census of our city and surrounding country were prepared for their use. The outline read:

Name of bird.
Description.
Date observed.
Shape of bill (draw).
Habits (describe from observations and from books read).
How helpful to man.

The census taking was conducted in the form of a contest between the scout troops, and when concluded the filled-in outlines were given to the schools, where they were used in connection with the Audubon Bird Charts which the pupils were coloring.

The campfire girls appeared before the lower grades with bird stories and songs. Sometimes these bird songs were accompanied by the sweet notes of a canary, brought to the schoolroom for the occasion.

Assistance was also kindly given us by bird authorities from the state university and by members of the Isaac Walton League, who appeared at school convocation and before the men's and women's clubs with interesting talks. Many pleasant trips were made to the University Museum, which is open to the public at all times.

The city librarian played her part with the bird books and bird pictures at her disposal at the library, by directing the attention of the young readers to these books and pictures. About this time the book dealers discovered they had bird books in stock and proceeded to display them in their shop windows.

In no small way the Parent-Teachers Association helped along the movement with its programs, one of which was a talk by the school superintendent on the benefits of nature study in the schools.

The time came when the bird houses and feeders were completed in the manual training department. A picture was taken of them, with their proud owners. The picture appeared on the front page of the local newspaper, and this, of course, delighted the boys and girls. Later, the bird houses and feeders, with the names of the builders attached, were put on display in various show windows of the city. Prizes for the best bird house and feeder and the most complete bird census were awarded by the business men's club. The city purchased some of these bird houses and they now adorn our city park, furnishing comfortable homes for the beautiful songsters and inspiration to the lovers of birds.

Good team work in creating an interest and in keeping that interest alive by the community itself is the best way that nature study activities in a community can be articulated.

The Training of the Teacher in Science for The Elementary School

B. C. Berg,
Superintendent of Schools, Newton, Iowa.

With a new subject like Elementary Science and Nature Study in the lower grades of the public school system, the number of teachers are scattered, and thus far no attempt at a scientific evaluation of the best training for a special teacher in this subject has been made. The personality, and an interest on the part of the teacher in her subject matter, are often more valuable than credits in a succession of highly specialized courses in different fields of science.

My own observation in this field is in the city of Newton, with a school enrollment of 2,900 pupils. The platoon type of organization is used in the elementary schools, and each special science teacher conducts science classes in special rooms. Every pupil from the third through the sixth grade has one period every day in science.

We have used experienced teachers with college degrees in science; we have also used teachers without degrees. The latter have possessed those excellent teaching techniques that we believed successful in the science room: an interest in science, and a strong desire to make an outstanding achievement in this field. The college graduate with a major in biology or some other field, is usually anxious to work in the more specialized subjects that are open in the secondary school. Her heart does not seem to adapt itself to the variety of scientific problems of an elementary character that are found in the elementary schools. At present it is difficult to secure any college graduate in science who has had university preparation for elementary school science. If college graduates have been used, they have usually been prepared as specialists in a major science.

The problem of training has thus come back to the school that organizes a science course in the lower grades. One successful teacher was found, in her sophomore year at the State University, with an interest in science, and she was permitted to work out lesson projects under supervision in the university experimental school. She was able thus to discover the successful means of approach in the science field for elementary chil-

dren. Another very successful teacher was a grade school teacher in a small city. I do not believe that she knew so much about science when she started, but she was observant, ambitious and inventive. Step by step she has added to her own knowledge, as she saw opportunities for lesson projects. At the present time, if a vote were taken among the 110 teachers of the entire system as to who was doing one of the most outstanding jobs, I think that we would find the majority listing her work as first. A summer in the nature school conducted by the University of Cleveland, and a summer in a traveling university, in which she took museum work for credit, has done much to help her. But her biggest asset is that she sees questions in the life around her, shows them to children, and together they start out to answer them.

Another appointee is making excellent progress, but she has not had the teaching background of the previous teacher. The training on the job seems to be the one that gets results. We have been fortunate in having a working agreement with Miss Hethershaw of Drake University by which much of her material has been tested out experimentally in our classrooms, and the teachers have received the benefit of her counsel.

We use no textbook but rely entirely upon the demonstration method in teaching science. The teacher must acquire the ability to make the type of apparatus and teaching equipment that gets results. She must find sources of material. She must learn the possibilities in science study in her own school community and the individuals who can most aid her with materials. This is training on the job. Best of all is the training she receives while being closely associated in experimental work with some of our pioneers and leaders in this field. In spite of all these qualifications there must be a native curiosity in the teacher which can be transmitted to others.

Science is one of the big subjects of the elementary school curriculum at Newton; it touches more things in the everyday life of the child than any other subject. During the elementary years no child takes the world for granted. It is a continual "Why? Why? Why?" The science teacher must be one who still has retained the "Why" spirit of childhood. All the training in the world will not help her much unless she can develop this essential trait.

A Comparison Between the Biological Content of Certain Periodical Literature and the Kansas High School Course of Study

HARRY A. HILL, Turlock, California.

This study proposes to compare the biological content of general periodical literature with that of the Kansas High School Course of Study. It assumes that editors of magazines publish only that literature in which the public is interested, and that the public is most interested in that literature which treats of its social desires and social needs. If these premises be granted true, then the articles appearing in widely circulated magazines of a general nature give an index to the social desires and needs of the people. Hence those topics most often and most fully discussed in articles of such magazines ought to aid us in evaluating the social worth of our High School Courses of Study. However, probably no really desirable Course of Study could be built up or evaluated by means of selecting topics most often and most fully discussed in magazines. Love stories are found more abundantly in our general purpose magazines than are articles of any other class of literature, yet, likely no educator in the country would insist that the art of love-making ought to be taught in our high schools.

The following principles have been used in selecting data for the magazines reviewed:

1. The principle of the frequency of the occurrence of anything.
2. The principle of the fulness with which a thing is discussed.
3. The principle that knowledge easily acquired outside of school need not be taught.

The principle of the truthfulness of things has not been used in this study in selecting material. At times, even in the best of our general purpose magazines, the veracity of the subject matter presented needs to be questioned.

The following references report quite fully investigations similar to the one made in this study.

Gambrill, J. M., *Experimental Curriculum-making in the Social Sciences*, 1924. McKinley Publishing Co., Philadelphia, Penn.

Various Authors, *22nd Yearbook, National Society for the Study of Education*. Public School Publishing Co., Bloomington, Illinois, 1923.

Caldwell, Otis W., *Types and Principles of Curricular Development*. School and Society, 17: 309-316, March 24, 1923.

Caldwell, Otis W., and Finley, Charles W., *Social Use of Biology.* Educational Review 66: 157-166.
Hopkins, L. Thomas, *A Study of Magazines and Newspaper Science Articles with Relation to Courses in Sciences for High Schools.* School Science and Mathematics, November, 1925.
Caldwell, Otis and Finley, Charles W., *Biology in the Public Press.* Lincoln Teachers College, Columbia University, New York City, 1923.
Gambrill, J. M., *Fact Courses in the Social Studies.* Historical Outlook, December, 1923.
Chartus, W. W., *Curriculum Construction.* The Macmillan Co., New York City, 1923.
Bobbitt, Franklin, *How to Make a Curriculum.* Houghton Mifflin Co., Chicago, Illinois, 1924.
Bobbitt, Franklin, *Curriculum Investigations,* Supplementary Educational Monographs, No. 31. The University of Chicago, Chicago, Illinois, 1926.

The purpose of this study is:

1. To discover the biological content of non-specialized American magazines.
2. To evaluate, by means of this content, the Kansas High School Course of Study in Biology.
3. To suggest possible improvements in that course of study.

A choice of magazines for the purpose of this survey was made after examining about fifty of our best known publications. The basis for selection was that of content. Most magazines specialize in particular fields of thought and cater to special classes of people as, teachers, ministers, farmers, mechanics, or scientists. Since it was desired to know only what the general public demanded in the way of reading matter, all specialized magazines were eliminated from the list used in this survey. The following seemed most suitable for review:

1. American Magazine
2. Atlantic Monthly
3. Harper's Magazine
4. Literary Digest
5. McClure's Magazine
6. Scribner's Magazine
7. World's Work
8. Saturday Evening Post
9. Cosmopolitan

Of the last two magazines only a few copies could be found in our libraries, so were slightingly considered. All numbers of the other magazines mentioned were examined for the years from 1921 to 1925 inclusive.

The data collected on reviewing the magazines were recorded as shown in Table I. Under the heading "Length" was stated the length of the article in column-inches. By column-inches is meant the length of the reading matter in any magazine as measured by the length and size of a column of reading matter in the Atlantic Monthly. Under "Ratio" was stated the ratio

TABLE I.

Magazine	Date	Author
Harper's	October, 1921	L. S. Porter

Article Outlined	Length	Ratio	Topics	Vocabulary
Spider characters:	32"	.015	Structure in webs	Spiders
1. The common nest of two spiders.			Spiders' nests	Arachnes
2. Structure of this common nest.				
3. Maternal instinct of the two spiders tested.			Spider characters	Prenatal
A. The nest was shaken. Both spiders rush to defend the nest.				
B. The nest shaken again. Both spiders rush to defend the nest again.				
C. The nest was now nearly torn from the web. One spider rushes to defend the nest again. The other spider runs away to hide.				
4. Conclusions—				
A. One spider was a coward.				
B. The other spider was a brave defender.				
5. Moralizations to be drawn from these spider characteristics				

in percent of the amount of reading matter in any article to that of the whole magazine. Under the head "Topics" were listed all the topics of biology in the article. Under "Vocabulary" were given all biological terms. Altogether 591 numbers of the magazines were surveyed and a total of 861 articles were read. The number of column-inches read, as measured by a column of reading matter in the Atlantic Monthly, was 55,839. All the topics discussed in each article were classified under proper headings.

Next the Kansas High School Course of Study was examined for its biological content. For ease of comparison all data now collected was assembled as shown in Table II. In this table, under the title "Magazine content," are listed all the topics found in the magazines read that are—

1. Identical with those in the Course of Study.
2. Similar to those in the Course of Study.
3. Valuable for understanding the articles read in the magazines.

TABLE II. (Sample page)

Kansas Course	Magazine Content	References
I. Insects		
A. Orthoptera		
1. Adaptations	Adaptations	McClure's, Jan. 1926, p. 456
2. Protections	Protections	" " " "
3. Locomotion	Locomotion	" " " "
4. Food- getting	Food-getting	" " " "
5. Breathing		
6. Body-regions	Body-regions	" " " "
7. Excretions	Excretions	" " " "
8. Nervous system		
9. Reproduction	Reproduction	" " " "
10. Life history	Life history	" " " "
11. Metamorphosis	Metamorphosis	" " " "
12. Economic importance	Economic importance	" " " "
13. Classification	Classification	" " " "
B. Hemiptera		
1. Adaptations	Adaptations	Lit. Digest, Oct. 3, 1925, p. 21
2. Food-getting	Food-getting	" " " " "
3. Reproduction	Reproduction	Lit. Digest, June 9, 1923, p. 25
4. Life history	Life history	" " " " "
5. Economic importance	Economic importance	Lit. Digest, June 9, 1926, p. 256
6. Classification	Classification	Lit. Digest, Jan. 8, 1921, p. 29
7. San Jose Scale	San Jose scale	
C. Coleoptera		
1. Beetles	Beetles	Scribner's, Mar. 1925, p. 477
2. Economic importance	Economic importance	Harper's, Mar. 1925, p. 435

Under the column headed "References" are given citations to the magazine article containing these topics.

In Table III is given a sample page of a classified list of the topics of a biological nature discovered in the survey of the magazines mentioned in this study. No topic is entered here the discussion of which does not occupy at least three or more column-inches of space in the magazine from which it is taken. The number accompanying each topic in the list gives the number of times it was found discussed in the magazines surveyed. In the list the topics given have been classified as nearly as possible to the way the same topics or similar ones have been classified in the Kansas Course of Study.

In Table IV of this abstract are listed the groups and the sub-groups of biology that were discussed in the magazines surveyed. The total amount of space devoted to biology in the

TABLE III. (Sample page)

Topics	Times this Topic was Discussed
F. Diptera	
1. Mosquitoes	
a. Importance	4
b. Classification	1
c. Adaptations	2
d. Life history	4
e. Methods of control	2
f. Diseases carried by mosquitoes	4
g. Minnows as mosquito controls	2
2. Tsetse flies	
a. Where found	2
b. Habitat	2
c. Method of control	2
d. Disease carried by this fly	2
3. Hessian fly	
a. Damage they do	3
b. Method of control	3
4. House flies	
a. As disease carriers	1
b. Rate of reproduction	1
c. Fly diseases—fungus	1
d. Life history	1
5. Petroleum fly	
a. Habitat	1
b. Food	1
c. Structure	1

magazines reviewed was 55,839 column-inches. In columns II and III of this table is stated the portion of this space devoted to each group and sub-group of biology as listed. In columns IV and V is stated the same thing in percentages. In column VI is given the number of times each of these groups and sub-groups were discussed.

Several conclusions seem to be warranted by the data secured in this study. Table IV seems to suggest these things:

1. Animal biology is the most important branch of biology found in our general purpose magazines. The most of the

SAMPLE PAGE OF VOCABULARY.

1. Adjutant	14. Anteater	29. Baboon	42. Bighorn
2. Agouti	15. Antelope	30. Bacillus	43. Bison
3. Albatross	16. Ants	31. Bacteria	44. Boar
4. Albacore	17. Anopholes	32. Badger	45. Boa constrictor
5. Alewives	18. Apes	33. Bagworm	
6. Amberjacks	19. Aphids	34. Barracouta	46. Bobolink
7. Alligators	20. Archeopteryx	35. Barnacle	47. Boll-weevil
8. Amoeba	21. Argoli	36. Basha	48. Bonefish
9. Ampella	22. Armadillo	37. Bass	49. Bonita
10. Ammonites	23. Armyworm	38. Bat	50. Booby
11. Anaconda	24. Ass	39. Beaver	51. Bowerbird
12. Angleworm	25. Ascaris	40. Bear	52. Blackfish
13. Angelfish	26. Axotyl	41. Beetle	

TABLE IV.

I	II	III	IV	V	VI
Classification	Total Discussion Main Topics Col.-Inches	Total Discussion Sub-Topics Col.-Inches	Percentage of Space Main Topics	Percentage of Space Sub-Topics	Frequency of Discussion
A. Animal Biology	29,262	29,262	52.40	52.40	1,798
B. Human Biology	16,096	....	28.62	....	....
1. Health	....	13,838	....	24.80	504
2. Eugenics	....	1,918	....	3.44	40
3. Food	....	340	....	.61	66
C. General Biology	7,080	....	12.69	....	....
1. Evolution	....	3,582	....	6.41	101
2. Biol. Principles	....	1,192	....	3.13	12
3. Great Biologists	....	930	....	1.66	93
4. Agric. Biology	....	720	....	1.26	17
5. Heredity and Genetics	....	674	....	1.20	33
D. Plant Biology	3,401	3,401	6.09	6.09	181
Totals	55,839	55,839	100.00	100.00	2,844

animal biology presented consists of nature study wherein are set forth descriptions of the appearances, habits, etc., of wild animals. It is this sort of biology that seems to appeal most of any to the leisure interests of people.

2. Human biology is the next most important branch of biology found in our general purpose magazines. Under it the biology of health ranks as the most important sub-division, the biology of eugenics as the second most important sub-division, and the biology of food as the third, or least important sub-division.

3. General biology is the next most important branch of biology found in our general purpose magazines. Under this branch the sub-division ranking as first in importance is evolution; as second in importance is biological principles; as third is biographies of great biologists; as fourth is agricultural biology; and as fifth is heredity and eugenics.

4. Plant biology is the least important branch of biology found in our general purpose magazines.

As to the question whether our High School Course of Study in General Biology prepares students taking it to read intelli-

gently the biology appearing in periodical literature, the following conclusions seem justified:

If students are taught only that biology that is contained in the Kansas Course of Study for General Biology:

1. They are prepared to read easily about 89% of the biology found in general purpose magazines.
2. They are prepared to read with difficulty about 11% of the biology found in general purpose magazines.

The conclusions stated above would likely be true even though high school students had taken all the courses in biology of all the high schools of the country.

In the light of the facts presented in this thesis, it would seem probable that the Kansas High School Course of Study the biological sciences could be improved by the addition of:

A. Topics explaining the meaning and nature of
   1. Eugenics.
   2. Genetics.
   3. Evolution.

B. Topics treating more fully nature study of animals. Probably all these topics except those on genetics could profitably be added to the course in General Biology.

The Kansas High School Course of Study does not stress the topics "heredity," "eugenics," "genetics," and "evolution," but evolution is pretty thoroughly discussed in the state-adopted textbook.

The conclusions stated in the thesis are probably correct, but there can be no certainty of this until high school students of biology are tested in some adequate way regarding their understanding of current biological periodical literature.

Achievements of Students in Physics

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This article presents some concrete data on the achievements of students in high school and university physics. The present time is peculiarly a time for gathering and presenting factual data. So many questions are being asked concerning present and past procedures in all walks of life and the opiniated answers of some are being found so inadequate, that the need for more factual data is evident. Much of the data presented in the field of education oftentimes seems useless and the reasons for gathering it not always apparent, so that there have appeared caricatures of the educationist with his masses of charts, tables, and the other paraphernalia, not apparently proving anything. The situation merely shows the present status of research in the educational field. It is relatively new, and in the discovery of real laws and principles in any field, progress is necessarily slow. Accumulation of facts is the first stage in any science, and this is preeminently the present stage in education. The data presented here are representative of attempts to gather facts, which, it is hoped, may serve as foundations for the collection of more facts, and their final use in making possible worthwhile interpretations which may result in the formulation of valuable guiding principles.

These data were not collected at any one time or for any one purpose, but were incidental to certain projects in experimental education carried on at the University of Minnesota. For example, one project involved the values obtained from laboratory work in a course of mechanics; another the effects of size of class as a feature of instruction in magnetism and electricity; another, a study of a prognosis test for mechanics with a second class in mechanics; and another, a project of developing units for a course in high school physics. Their relatedness exists only in giving some common factual data on achievements of students in university and high school physics.

In the fall of 1927, a comprehensive test covering the field of high school physics was given to all students enrolled in the university course in mechanics. This was given prelimi-

nary to the course and consisted of 191 items. Some of these items were informational; others were problems. It was found that a considerable number of the students had not studied high school physics. Therefore an opportunity was presented for comparing the achievements of those who had taken the high school course and those who had not done so. Foley,[1] of Indiana University, gave score distributions a few years ago showing that the high school course in physics failed to impart ability to solve certain problems which were supposedly included in the high school course in physics. His test consisted of but ten of these problems, and the results were disappointing to high school teachers of physics. As a matter of fact, it has become quite commonplace for test results to be disappointing, if teachers have any expectation of 100% correct response to all items in the test. Probably, one of the most significant truths learned through our recent testing programs, is the failure of students to accomplish any large fraction of the supposed requirements of courses pursued. In other words, what the teacher thinks he is teaching is usually many times what he actually teaches. Or, the other way round, the pupil is learning but a very small part of what the teacher thinks he is learning. To be sure, some of us have reached the place where we expect a comprehensive test to give a distribution of scores resembling what we call a normal distribution, but this has resulted from studies of actual distributions which have been tabulated. As a rule, a teacher must be the most optimistic person in the world in order to be happy on the job, for tabulated facts of achievement do not tend to produce optimism. About the only way to get satisfaction from tabulated distributions of achievements of one's own classes, is to compare them with similar distributions of other classes, and find that however far one's own pupils fall short, they are no worse than the pupils in other classes or schools.

To return to the test distributions of the university students, in the preliminary test covering the field of high school physics. Tables were constructed showing distributions of scores for the two groups: (1) those having had the high school course in physics, (2) those not having had this course. There were 191 items included in these tests. The tests were Hurd Tests

1 Arthur L. Foley: The College Student's Knowledge of High School Physics. "School Science and Mathematics," 22-601-612, Oct. 1922.

II, III, VI, VIII, X, and parts of Tests VII and IX,[2] covering the fields of machines, mechanics of liquids and gases, motion and energy, light, sound, heat, and magnetism and electricity. They had been given to several hundred high school pupils previously, and tentative norms were therefore available. Table I gives a summary showing the ratings of the two groups in the added scores of all tests.

TABLE I.—*Summary of Test Ratings in Hurd Tests.*

	1	2
Mean Score	80.65 ± 1.14*	42.50 ± 1.79*
Standard Deviation	25.5	21.0
Coefficient of Variability	.3	.5
Difference in means	39.15 ÷ 2.12* = 18.0	

* Probable error.

A study of these tables disclosed several things: (1) Students having had high school physics, on the average, had higher scores in every one of the tests, the superiority being regularly in the ratio of 2:1. (2) Some students who had taken the high school course recalled practically none of the material included in the tests. (3) Some students rated very high on the tests. (4) The median ratings in all tests were considerably lower than the established tentative norms, showing lack of retention since the high school course. (5) The score range for those not having the high school course was always less than for those having the high school course. (6) The difference between those having high school physics and those not having it, on the average, was great enough to generalize the principle that for any similar sampling there would always be a difference on the items in the tests.

In general, these conclusions have been substantiated by similar differences with the 1928 fall class in university mechanics. Table II shows the distribution of scores in the Minnesota High School Physics Test[3] given to this class in mechanics preliminary to the course in mechanics. The division is again made to compare those having high school physics and those not having it. This test is a refinement of the combined tests used in 1927, and consists of 87 items having a total possible score of 119. The test has a coefficient of reliability of .94 ± .003.

2 Available by addressing The Educational Test Bureau, University and 15th Ave. S. E., Minneapolis, Minn.

3 For information, address The Institute of School Experimentation, Teachers College, Columbia University.

TABLE II.—*Distribution of Scores in the Minnesota High School Physics Test for Those Enrolled in Mechanics, Fall* 1928. (*Possible Score,* 119.)

	HAVING HIGH SCHOOL PHYSICS		NOT HAVING HIGH SCHOOL PHYSICS	
Score	*Tally*	F	*Tally*	F
0— 4.9	'	1	'''''	10
5— 9.9	''''	5	'''''''''	15
10—14.9	'''''''''	12	'''''''''''''''''''	29
15—19.9	'''''''''''''''''	23	'''''''''	13
20—24.9	'''''''''	16	'''''''''	13
25—29.9	'''''''''''''''	23	''''''	10
30—34.9	'''''''''''''''''	24	'''''	5
35—39.9	'''''''''''''''''''	28	'''''	8
40—44.9	'''''''''''''	23	'''''''	11
45—49.9	'''''''''''''''''	25	''	2
50—54.9	'''''''''''''''''	26	'	1
55—59.9	'''''	10	'	1
60—64.9	'''''''''	14	'	1
65—69.9	'''''''''	11	'	1
70—74.9	'''''	10		0
75—79.9	''''	4	'	1
80—84.9	'''	3		0
85—89.9	''''	4	'	1
90—91.9	'	1		0
95—99.9	''	2		0
		265		122
Mean		41.75 ± 1.19*		20.30 ± 1.41*
S. D.		19.45		15.55
C. V.		.47		.77
Diff. ÷ S. E.* of Diff.		21.45 ± 1.85		
Difference in means		11.6		

* The standard error is used in this table and those which follow.

The mean score of those having the high school course is approximately twice that of those not having the high school course. The score range is less for those not having the high school course, but the coefficient of variability about the mean is greater.

Similar distributions were obtained for a class enrolled in a university course in magnetism and electricity in the spring of 1928. The pre-test given in this case was the Hurd Test X, consisting of 42 test items covering the field of the high school course in magnetism and electricity. Table III presents a summary of the data.

TABLE III.—*Summary of Scores in Hurd Test X to Students Enrolled in the University Course in Magnetism and Electricity, Spring* 1928.

	HAVING HIGH SCHOOL PHYSICS	NOT HAVING HIGH SCHOOL PHYSICS
Mean	20.24 ± .49	13.44 ± .89
S. D.	7.71	6.77
Difference in means		6.80 ± .93
Diff. ÷ S. E. of Difference		7.3

The mean score of those having the high school course is considerably greater than those not having it, though the difference in the groups is not quite as great as in the two previous cases.

While a canvass of the knowledge of high school physics on the part of students enrolling for university physics is interesting, it is equally important to know whether or not a knowledge of the high school course tends toward higher achievement in the university course. It is apparent that students having high school physics have average ratings in this subject matter approximately twice that of students not having the high school course, at the time of entrance to the university course in physics. But do they make use of this advantage in their achievements in the university course? From the data gathered in the studies already mentioned, it was possible to prepare some distributions bearing upon this point. For example, in the course in mechanics in the fall of 1927, the numerical percentage ratings in mechanics for the same group of students included in Table I were tabulated. Table IV shows a summary of these distributions.

TABLE IV.—*Summary of Final Achievement Ratings in Mechanics, Fall,* 1927.

DISTRIBUTIONS

	HAVING HIGH SCHOOL PHYSICS	NOT HAVING HIGH SCHOOL PHYSICS
Mean	50.28 ± .64	46.05 ± 1.23
S. D.	9.97	8.65

Difference in means 4.23 ± 1.39
Diff. ÷ S. E. of Difference = 3.04

These achievement ratings in mechanics are based on weekly quizzes and a two-hour final examination. The tests comprised three objective tests and six subjective or essay type tests. There is evidence showing the latter to be fairly reliable and quite valid. They show some points of superiority over the objective tests. An examination of the table shows the average rating for the group having high school physics significantly higher than for the group not having the high school course. On the average, then, the evidence shows that the high school student who had taken the high school course in physics rated higher in the course in mechanics at the University of Minnesota. The original, complete table shows, however, that 14 out of 52 students not having the high school course have ratings equal to or above the mean rating of 243 students having the high school course.

There is similar evidence from the class in magnetism and electricity, spring 1928. Table V shows a summary of numerical final ratings for the two contrasted groups.

TABLE V.—Summary of *Ratings in Magnetism and Electricity, Spring,* 1928.

	HAVING HIGH SCHOOL PHYSICS	NOT HAVING HIGH SCHOOL PHYSICS
Mean	69.40 ± .87	65.99 ± 1.35
S. D.	12.00	9.45
C. W.	.17	.14

Difference in means 3.41 ± 1.61
Diff. divided S. E. of Diff. = 2.1

These ratings were computed very much like those for mechanics, from weekly quizzes and a final examination. The last hour quiz was an objective examination covering the quarter's work, and it was counted in the final mark as one of the weekly quizzes.

The mean score of those having the high school course in physics was somewhat greater than that of those not having the

high school course, but it was not as much greater as were the ratings in mechanics. The difference was but 2.1 times its standard error. We are probably justified in saying that there is some evidence that the average student in the university course in magnetism and electricity has a tendency to rate higher if he has taken the high school course in physics. The difference however is not surely significant. Twenty-two of 49 students not having the high school course rated at or above the mean of 189 students having the high school course.

Similar distributions were also prepared for the class in mechanics, fall, 1928. Table VI presents a summary of the ratings. No objective tests were given this quarter, but the marks were based on the regular weekly quizzes and final examination.

TABLE VI.—*Summary of Ratings in Mechanics, Fall,* 1928.

	HAVING HIGH SCHOOL PHYSICS	NOT HAVING HIGH SCHOOL PHYSICS
Mean	68.35 ± 1.03	64.00 ± 1.61
S. D.	14.80	13.85

Difference in means 4.35 ± 1.91
Diff. ÷ S. E. of Difference = 2.3

The difference between the contrasted groups was about the same in this case as in the class in magnetism and electricity, and the same conclusion may be drawn, viz., that there is some evidence showing that it is worth while for the average student to take high school physics in order to obtain higher ratings in mechanics at Minnesota. Forty out of 74 who had not taken the high school course, however, received ratings equal to or above the mean of 208 students having the high school course.

A question which always arises with distributions such as those given, is that of general mental ability of the groups of students contrasted. Some data for the groups already mentioned were available in the form of percentile ratings in a mental test given to all students entering the S. L. and A. College. Comparisons were made for the groups having high school physics and those not having it. There was a slight tendency toward a higher mean rating for the former group, but it was small, and when treated statistically, was not significant. In other words, the difference in the means of the groups divided by its standard error was considerably less than three. As a matter of fact, this ratio for the first two con-

TABLE VIII.—*Distribution of Scores in Preliminary and Final Tests I. Possible Score, 73.*

Score	*Pre-Test*		*Final Test*	
0— 4.9	//////////////////////////////////////	53	/	1
5— 9.9	//////////////////////////////////////	51	/	1
10—14.9	//////////////////////////	42	/////	8
15—19.9	//////////////////////	36	//////////	15
20—24.9	//////////////	24	//////////////////	27
25—29.9	///////	11	//////////////////////////	42
30—34.9	///	4	//////////////////////	35
35—39.9	/	1	///////////////	24
40—44.9	/	1	//////////////////	26
45—49.9		0	///////////////	24
50—54.9		0	/////	8
55—59.9		0	/////	8
60—64.9		0	///	4
		223		223
	Mean 12.21 ± 1.49		33.84 ± .8	
	S. D. 8.35		11.95	

trasted groups considered so far, was less than one. The distributions are omitted here for lack of space.

The data available from the experimental study in connection with the development of teaching units for high school are of somewhat different nature than the data so far presented. It is perhaps enough to say here, that several units were prepared to impart some useful information, techniques to use in solving problems, and appreciations of certain phases of science, with particular reference to physics. These units were tried out in several schools, and experimental data collected. Part of these data consisted of distributions of scores in preliminary and final tests prepared for each unit for the purpose of knowing the preliminary and final status of each pupil in the particular knowledge, technique, and appreciation elements which the unit was designed to accomplish. As a sample, the distributions of these scores for Unit I are given in Table VII. These show distinct gains in the scores on these tests, due to approximately three weeks of work.

Test distributions for other units, which have been made so far, are so similar to those for Unit I that they are not included here. The general conclusions to be drawn from them are the same as for Unit I.

A phase of an achievement study which shows the effects of instruction, is that concerned with the number of correct responses given by students before and after instruction. Even though score distributions, such as have been given, may be disappointing to teachers, they show some effects of instruction. This other method is merely another way of looking at the same matter. To how many test items are there more than 90% of correct responses; to how many are there 50% of correct responses; to how many are there 25% or less correct responses? A table giving such a tabulation for the preliminary and final tests of the first unit in the high school course spoken of above, shows the following:

For 239 high school pupils, no item finally received 100% correct response; but 3 items of 45 received as many as 90% correct responses; but 23 items received 50% or more; 22 items received less than 50%; and 4 items received less than 10%. There is however always a gain from preliminary to final, showing effects of instruction. These items were not such apparently difficult items. As a matter of fact, they

were, with one exception, listed as items to which all pupils, with diligent effort on the work of the unit, should be able to give correct responses, in the judgment of the one devising the test. The relatively small numbers of correct responses is confirmation of the same truth shown by the distribution of test scores, i. e., that pupils do not achieve what they are often expected to achieve.

Do the results of the tests of high school physics given preliminary to the university courses in physics, before referred to, substantiate these findings? A tabulation similar to that mentioned in the preceding paragraph, was made for the preliminary test in university magnetism and electricity, before referred to. Of 323 students taking the test, including 250 who had studied high school physics, but three simple questions of 42 given were answered correctly by 90% or more of such a group. Twenty-six were failed by 50% or more of the group. Fourteen were failed by 75% or more. For every item, however, except one, which had but two correct responses, there was a greater percentage of correct responses with instruction than without it.

Failure in the university course has often been ascribed to poor preparation in high school. Do the results of instruction at university levels show any more rosy picture of accomplishment than the records given? To answer this question, a tabulation of items in the final objective test in magnetism and electrictiy in the university was carried out. An examination of the table indicated no better accomplishment than that for high school students. There were shown but three items of 82 having 90% or more of correct responses; 34 items failed by 50% or more; and 15 items failed by 75% or more.

All this evidence merely shows how far short we as teachers are, of producing achievement which is expected. The great discrepancies between objectives and achievements are jarring to conscientious instructors and raise many questions. Are our objectives too high? Are achievements too low? Can we legitimately expect higher achievements? Are we selecting certain legitimate objectives and planning wisely for certain desired degrees of performance? Are we expecting high degrees of performance? Is education an opportunity or a requirement? Are teachers guides or task-masters? Certainly if requirements are set up as represented in test items, of

which a high degree of achievement is expected, such tabulations as these given, must bring great disillusionment.

One can but be led to a choice of a few conclusions: either (1) pupils are not putting reasonable efforts on the work; (2) the work is too difficult for those enrolling for the course; or, (3) correct methods are not being used in bringing about the desired achievement. The suggested remedy is that reasonable aims and objectives should be carefully devised and tested for bringing about desired degrees of achievement. These things cannot be done "over night," or by one or a few persons. Experimental try-outs, with careful records kept to secure factual data on achievement in relation to the objectives of the course and the various factors determining achievement, are in order. Only by such patient and painstaking procedures can better conditions be obtained in connection with school work.

A Useful Plant for Biology Teachers[1]

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Those botanists who are fortunate in having a greenhouse as a part of their working equipment, have usually stocked it with plants useful for demonstration or laboratory purposes. To them, as well as to those who have only a laboratory, I desire to point out the advantages of a locally common exotic plant, *Impatiens Holstii,* Engler and Warb, particularly since Bailey (Cycl. Amer. Hort.) states that relatively few of this genus are now in cultivation outside of botanical gardens. Most of what I have to state seems to apply also to *Impatiens sultani,* Hook, f.

ROOTS. Primary and secondary, tending, at least in cuttings, to develop mostly just below the nodes in a somewhat verticillate manner, although adventitious roots less regular in position also appear. Water roots develop in a few days and with abundant root hairs, while cuttings grow quickly when placed in moist soil.

STEM. Swollen at the nodes, succulent and soft. On account of its translucence, the course of the primary vascular bundles

1 Contribution from the Biological Laboratory, Elizabethtown College, Elizabethtown, Pa.

is easy to follow. A transverse section epidermis, collenchymatous cells, thin-walled parenchymatous cells, and intercellular spaces. The epidermis is excellent for demonstrating cell structure when stripped off and stained with iodine. The plant is also useful for experiments illustrating geotropism. The buds are axillary and readily develop into new branches.

LEAVES. Simple, alternate, ex-stipulate, petioled, ovate or ovate lanceolate. They are smooth and shining, as in many tropical plants. The upper epidermis is somewhat thickened, and bears emergences (hydathodes) useful in demonstrating guttation. A section brings out the presence of idioblasts in the leaf, and these dissolve in weak hydrochloric acid. Slightly crushing the leaf between the cover glass and a slide permits one to see the termination of the fibrovascular bundles. Epidermis removed from the lower side of the leaf shows abundant stomata.

FLOWERS. These are about one inch in breadth. Bisexual, irregular, solitary or clustered in the axils. Dimorphism in the sepals, and forming a honey spur. Stamens alternate in the petals, coherent and connivent. Ovary five celled, three to many ovules in each cell. Style short, five lobed stigma. The flowers are scarlet, pink, or white, blooming plentifully during the winter months and the year around. Ellipsoidal pollen grains, at least in *sultani*. Cleistogamous flowers are known from other species of this genus, but I have not observed them up to this time in *Holstii*.

FRUIT. An oblong or linear capsule, elastically dehiscent into five coiled valves, expelling the seeds. The ripe pods burst open when touched.

Bailey (loc. cit.) remarks that the genus has not been developed horticulturally and offers great possibilities for productive horticultural work. An aid here will be the ease of propagation. Provided the temperature does not fall too low and that it is regularly watered, the plant is quite hardy under usual laboratory conditions, and all in all seems to make a useful as well as ornamental addition to the laboratory.

Deficient Treatment of Organic Chemistry in Secondary Schools

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The fact that for many years there has been so little change in the content and arrangement of the chemistry course, as represented by commonly-used textbooks, leads one to question whether authors have seriously attempted to adapt their material to the vastly altered conditions of modern life and industry. Only one phase—but mayhap the most important phase—of this inquiry is answered in this study. The most striking contrast between the needs of men in this and in earlier periods is the vast increase in the use—and therefore manufacture—of *organic* chemical products. It is common knowledge that the recent practical advances of chemistry have been largely in the organic field; that the miracles of synthetic manufacture which have given hundreds of hitherto unknown luxuries and necessities to man, are triumphs of the *organic chemist.*

Many questions then arise concerning the material in text-books of chemistry. Are the texts giving as much attention to organic chemistry as it deserves? Of the well-known organic substances, how many are ever mentioned in the usual high school chemistry text? Of the organic materials mentioned, what particular class or organic substance leads in number of times mentioned? How does the total number of organic substances mentioned in the text compare with the total number of inorganic substances mentioned? How do popular books written for use as supplementary material compare with the text-books in their treatment of organic chemistry? What fields of organic chemistry are offered to students in texts and supplementary books? What fields are considered most important? Are the various authors in agreement as to these groups of organic compounds, and their relative importance? Is there a different selection and presentation in text-books in comparison with supplementary books?

In order to answer these questions it is first necessary to explain what is meant by the term *organic substance.* Organic chemistry at one time was defined as the chemistry of the compounds elaborated under the life process. As compound after

compound was successfully synthesized in chemical laboratories without the aid of the life process, the idea was replaced with a new definition, in which the term organic chemistry is considered to be the chemistry of the carbon compounds. However, this title is perhaps too broad to be distinctive, and the chemistry of the hydrocarbons and their derivatives is usually all that is implied. This assigns the carbonates, oxides of carbon, etc., to the field of inorganic chemistry.

The question has been asked: "Are the texts giving as much attention to organic chemistry as it deserves?" How may this "attention given to inorganic topics," likewise "to organic topics," be measured numerically, so that comparisons may be made? Certain qualities of treatment are not susceptible of quantitative treatment; they are matters of style, types of illustration, relation of principle to application, and the like. The most cursory examination plainly shows that the differences lie primarily in the space devoted to the separate fields. A count of topics, therefore, will permit a fair comparison of "the attention given in a book to organic and inorganic fields." Each mention of a chemical substance is designationed as a topic.

Twenty-five books were selected for examination. All titles selected are in the Publisher's Trade List for 1925. The style and the purpose of the book were used as a basis of a separation into two classes, namely, texts and supplementary books. All books placing customary emphasis upon the occurrence, preparation, and properties of chemical substances, logically arranged under appropriate headings were designated "Textbooks," and lettered from A to M in order of publication. All books written in popular style for general readers were labeled "Supplementary Books," and lettered from N to Y according to year of publication. A key, showing book symbol, title of each book and date of publication is inserted at the close of this study.

The twenty-five books contain a total of 11,176 pages, exclusive of all tables of contents, prefaces, appendices, and indices. These pages were read one by one and a card of notes prepared for each page. Each card was inscribed with book symbol and page number, to provide a means of future identification. All organic chemical substances named on the page were written in one column, all inorganic chamical substances were written

in a second column. If the same name was printed more than once upon a page, each occurrence of the name was recorded.

The number of organic topics in each book was obtained by a careful count of the organic names listed on the cards. The number of inorganic names or topics for each book was ascertained in like manner. The organic topics were then classified under nineteen headings: "Foods and Feeds," "Solvents," "Petroleum," "Coal and coal products," "Organic acids," "Explosives," "Wood and wood products," "Soaps," "Textile fibers," "Preservatives," "Miscellaneous," "Painting materials," "Rubber," "Animal products," "Medicines," "Dyes," "Resins," and the synthetic resins grouped under the term "Bakelite." Tables and graphs have been prepared from these data. These 65 graphs show the percentage of organic and inorganic topics in books, the rank of different fields of organic chemistry presented in texts and supplementary books, the percentage composition of organic material in each book, the rank of texts in each field of organic chemistry, and the rank of supplementary books in each field of organic chemistry.

SUMMARY

(1) There is a decided tendency to increase the number of organic topics included in texts written since 1920.

(2) The percentage of organic topics in supplementary books is much larger than for texts.

(3) Texts and supplementary books written by the same authors show a marked increase in the number of organic topics included in supplementary books.

(4) Texts and supplementary books have practically the same median for the average number of topics per page.

(5) Twenty-two books of the twenty-five examined contain a larger number of inorganic topics per page than organic topics.

(6) "Foods and Feeds" is evidently considered the most important field of organic chemistry, as shown by the agreement of the authors in placing it first in every book.

(7) The authors seemingly agree to place "Petroleum" second and "Solvents" third. There is wide variation among authors in their treatment of other fields, some fields deserving more attention than they are receiving.

(8) There is a very marked difference in the selection and presentation of organic chemistry topics in texts and supplementary books; an evidence of this is the far more adequate treatment found in the supplementary books.

KEY TO BOOKS.

TEXT-BOOKS.

A—Chemistry; An Elementary Text-Book. By William O. Morgan and James A. Lyman. Macmillan. 429p. 1911
B—Essentials of Chemistry. By John G. Hessler and Albert L. Smith. Benj. H. Sanborn & Co. 505p. 1912
C—Foundations of Chemistry. By Arthur A. Blanchard and Frank B. Wade. American Book Co. 446p. 1914
D—Practical Elementary Chemistry. By B. W. McFarland. Chas. Scribner's Sons. 336p. 1915
E—An Elementary Study of Chemistry. By William McPherson and William Edward Henderson. Ginn and Co. 576p. 1917
F—Principles of Chemistry. Joel H. Hildebrand. Macmillan Co. 306p. 1918
G—Practical Chemistry. By N. Henry Black and James Bryant Conant. Macmillan Co. 457p. 1920
H—Elementary Principles of Chemistry. By Raymond B. Brownlee and Others. Allyn and Bacon. 588p. 1921
I—Practical Chemistry. By Lyman C. Newell. D. C. Heath & Co. 543p. 1922
J—A First Book in Chemistry. By Robert H. Bradbury. D. Appleton & Co. 687p. 1922
K—Smith's Elementary Chemistry. By James Kendall. Century Co. 423p. 1924
L—Fundamentals of Chemistry. By C. W. Gray. C. W. Sandifur and H. J. Hanna. Houghton Mifflin Co. 456p. 1924
M—High School Chemistry. By Charles E. Dull. Henry Holt and Co. 577p. 1925

SUPPLEMENTARY BOOKS.

N—Chemistry and Its Relation to Daily Life. By Louis Kahlenberg and Edwin B. Hart. Macmillan Co. 320p. 1913
O—Chemistry of Common Things. By Raymond B. Brownlee and Others. Allyn and Bacon. 616p. 1914
P—Chemistry in the Home. By Henry T. Weed. American Book Co. 385p. 1915
Q—Chemistry of Farm and Home. By William Edward Totlingham and Joseph Waite Ince. Webb Publishing Co. 1916
R—Creative Chemistry. By Edwin E. Slosson Century. 311p. 1919
S—Everyday Chemistry. By Alfred Vivian. American Book Co. 560p. 1920
T—Chemistry and Its Uses. By William McPherson and William Edward Henderson. Ginn and Co. 530p. 1922
U—Chemistry in Everyday Life. By Charles G. Cook. D. Appleton and Co. 454 pp. 1923
W—Chemistry in Industry. Vol. I. By H. E. Howe, Editor. The Chemical Foundation, Inc. 372p. 1924
X—Chemistry in Industry. Vol. II. By H. E. Howe, Editor. The Chemical Foundation, Inc. 392p. 1925
Y—Chemistry for Boys and Girls. By Carlotta C. Greer and J. Cora Bennett. Allyn and Bacon. 776p. 1925

The following groups of tabular material are fairly representative of the tables used for comparative purposes. Space does not permit the inclusion of any of the graphs used.

TABLE V.—*Percentage of Organic Topics in Text-Books.*

Date	Book	Organic Topics	Inorganic Topics	Total	Per Cent Organic
1911	A	882	6847	7729	11.4
1912	B	1620	9563	11183	14.4
1914	C	843	6219	7062	11.8
1915	D	752	8394	9146	8.2
1917	E	1437	9908	11345	12.0
1918	F	474	3520	3994	11.9
1920	G	1523	5030	6573	23.1
1921	H	1639	9094	10633	14.5
1922	I	1572	8832	10404	15.1
1923	J	2757	11033	13796	19.9
1924	K	1482	7024	8506	17.3
1924	L	1905	5669	7574	25.1
1925	M	2606	7294	9900	26.3

TABLE VI.—*Percentage of Organic Topics in Supplementary Books.*

Date	Book	Organic Topics	Inorganic Topics	Total	Per Cent Organic
1913	N	2853	3904	6757	42.2
1914	O	3722	5296	9018	41.2
1915	P	3711	3772	7483	49.6
1916	Q	2665	3904	6169	36.7
1919	R	3023	1896	4919	61.4
1920	S	2999	6584	9583	31.3
1922	T	1860	5873	7733	24.1
1923	U	2718	5656	8374	32.4
1923	V	552	1413	1762	19.9
1924	W	3543	2525	6068	58.3
1925	X	2814	2536	3350	52.6
1925	Y	5606	13196	18802	29.9

TABLE VIII.—*Average Number of Topics per page Text-Books.*

Symbol	Organic Topics	Inorganic Topics	Total Topics
D	2.2	25	27.2
B	3.2	18.9	22.1
I	3.4	17.9	21.3
K	3.6	17.4	21
J	4.1	16.7	20.8
A	2.1	16.9	19
H	2.6	15.7	18.3
L	4.5	13.4	17.9
M	4.7	13.2	17.9
E	2.3	15	17.5
C	1.9	14.6	16.5
G	3.3	11	14.3
F	1.5	11.5	13
Median	3.2	15.7	18.3
Range	1.5 to 4.7	11 to 25	13 to 27.2

TABLE IX.—*Average Number of Topics per page Supplementary Books.*

Symbol	Organic Topics	Inorganic Topics	Total Topics
O	11.6	16.5	28
Y	7.2	17	24.2
U	6.9	14.2	21.1
N	8.9	12.2	21.1
P	10.1	10.2	20.3
Q	7.5	11.1	18.6
S	5.7	12.4	18.1
R	10.3	6.4	16.7
W	9.5	7	16.5
T	3.5	10.7	14.2
X	7.1	6.5	13.6
V	2.1	6.6	10.7
Median	7.2	11.1	18.1
Range	2.1 to 11.6	6.4 to 17	10.7 to 28

TABLE XXI.—*Rank Table for Distribution by Number of Topics in Each Field of Organic Chemistry.*

Texts	1	2	3	4	5	6	7	8	9	10	11	12	13	Least Sum	Med. Rank	Med. Dev.
M	9	2	7	1										38	2	1
J	4	5	2	4	1			2				1		69	3	1
L	2	4	3	1	2	2	2	2					1	88	4	2
B	2	2	2	2	1	2	1	2		6				110	6	3
H		1	3	3	2	2	1	1	3	2	1		1	120	6	2
G	1	1	1	3	3	2	2	1	1	1		3		122	6	2
K	1	2	1	2	2	2	3			1	2	1	2	129	6	3
E		2			2	5	4	1	3	1			1	130	7	1
I	1			2	1	2	5	1	2	3	1	1		140	7	2
A					2			1	5	1	7	2	1	187	11	1
C							2	3	4	2	2	5	1	189	10	2
D				1		1	1	1	2	3	2	7	1	192	11	1
F					3	2	2		1		2		11	202	13	0

TABLE XXIV.—*Rank Table for Distribution by Number of Topics in Each Field of Organic Chemistry.*

Supplementary Books	1	2	3	4	5	6	7	8	9	10	11	12	Least Sum	Med. Rank	Med. Dev.
W	6	3	3		1	1	1	1	1		1	1	79	3	2
U	3		2	6		5	2	1	1				88	4	2
C		4	4	2	4			1		3			91	4	1
Y	6	2	2	2			2		1	1	1	2	92	3	3
R	3	5		2		2	1	2	1	2	1		96	4	3
S			1	3	6	3	1	2	2		1		109	5	1
X	2	1	4	1	6	1	1	2	3	1	2	1	120	7	4
P		2	1	2	2	2	3	2	4		1		121	7	2
N			2	2	1	3	2	3	1	3	2		136	7	2
T				1	4		2	1	4	2	3	2	159	9	2
Q		1				2	2	4	1	6	3		162	9	1
V											4	13	220	13	

TABLE XIV.—*Rank Table of Percentage Composition of Text-Books.*

Classes of Organic Chemistry	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Least Sum	Med. Rank	Med. Dev.
Food and Fd.	13																			13	1	0
Petroleum		9	3	1																31	2	0
Solvents		2	5	3	2	1														47	3	1
Coal and Prod.		1	4	5	2						1									55	4	1
Soaps			1		3	5	3	1												77	6	1
Organic Acids		1		2	2	4	1	1	1	1										78	6	1
Textile Fibers		1	1	1			1	2	4	1	1		1							105	9	1
Wood and Prod.					2		4	2	2	1			1	1						109	8	1
Explosives					1	2	1	4	2		1				1		1			117	8	1
Preservatives				1				1		2	2	2	2	1	2					148	12	2
Pt. Materials										2	2	4	1	1		2				149	12	1
Miscellaneous						1	1	1		3		1		3		2		1		154	12	2
Animal Prod.									1	2	1	1	3	1		1	1		1	157	13	3
Medicine							1		1		1	1	1	1	6	1				172	15	1
Dyes								1			1	4	2	1		1	3			174	13	1
Rubber									2	1	2		1	1	2	1	3			174	14	3
Perfumes													1	2	2	3	1	3	1	209	16	2
Resin														1		2	3	6	1	224	18	1
Bakelite																	1	2	10	243	19	0

TABLE XVII.—*Rank Table of Percentage Composition of Supplementary Books.*

Classes of Organic Chemistry	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Least Sum	Med. Rank	Med. Dev.
Foods and Fd.	12																			12	1	0
Petroleum		2	2	6				1	1											51	4	.5
Solvents		2	2	3	3	1				1										53	4	1
Textile Fibers		2	3	1	2	1		1	2											59	4.5	2
Coal and Prod.		2		1	3	1		3	1							1				62	5.5	2.5
Wood and Prod.		1		1		1	3	2	4		1									85	7.5	1.5
Soaps		2	1			4	1			1		1	1		1					88	6	3.5
Organic Acids			1		2	1	3	1			1		1		1	1				103	7	2
Explosives			1	1			1			3		3	1	2						108	11	1
Animal Prod.		1	1			1	2			1	1		2	1	1			1		119	10.5	3.5
Dyes					1	1		1	1	1			1	2		2	2			145	13.5	3.5
Medicines						1		1		1	1	2	2		1	1	1	1		151	12.5	2.5
Pt. Materials										1	3	2	1	3	2					152	12.5	1.5
Rubber								1	2		2		1	1	1	2	1	1		157	13.5	2.5
Preservatives							1		1	2	3	3		2						163	11	1
Perfumes			1				1				1	1		1	1		6			164	16	1
Miscellaneous								1		1			2		3	2	1		2	176	15	2
Resin															1	3	1	7		206	18	0
Bakelite																		2	10	226	19	0

An Assembly Program: A Pageant— Edison, Our Foremost Inventor

W. G. Whitman
State Normal School, Salem, Mass.

Two girls in white with appropriate headdress symbolize *Progress* and *Science*. They wear bands from the shoulder bearing the words — *Progress* and *Science* respectively. Both carry wands. At the two front corners of the stage are two small platforms (overturned boxes covered with paper or cloth, and large enough for a small table and chair). Around and upon one are devices, machines, art objects, books, products of manual work — this is Progress' throne. The other is surrounded by science apparatus — chemical, physical and biological—and by useful science devices, as field-glasses, microscope, telephone and electric lamps. This is the throne of Science. The rest of the stage is used for enacting the various scenes.

Progress and *Science* enter hand in hand. They separate and each mounts her throne.

Progress. "For thousands of years I have been almost discouraged about ever bringing this world into a high state of civilization, but with your help, dear Science, much encouragement has come to me, especially within the last one hundred years. May I count on you for the next one hundred years? If I may, I feel that we shall bring undreamed-of changes to the people of the earth."

Science. (*Rising*) "I have been on the earth as long as you, Progress, and have felt the same keen disappointments. The hardest work of all is in getting a start and in getting good helpers. I now have hundreds of splendid men and women devoting their lives to our cause. They are eager to learn and by their teachings, by their books they are preparing thousands of other helpers. I feel very hopeful of the future.

"Every day I visit all the boys and girls all over the earth, I wave my wand in their presence and try to attract their attention. I try to have them become interested in science. In many countries the children have so much school work to do they think they have no time for science, but a few years ago

I discovered a boy in Milan, Ohio, who didn't go to school. Go back with me to 1857. This boy seems so promising I spend much time in Milan. I almost get my wand hot waving it so that the start he has made may never grow less. He is now ten years old and spends all his money — for candy? — no — for chemicals and for science books. He has a laboratory in his cellar. His name is Thomas Alva Edison."

Progress. "We must follow events for the next hundred years with diligence. You know how I depend upon you, Science. Be sure to let me know just how your young Thomas comes along, won't you?"

Science. "May I now show you an incident in Thomas' life? He is twelve years of age. He is a newsboy, a book and fruit vendor in a train running from Port Huron to Detroit. He also edits, prints, and sells a news sheet of his own. To fill in spare time on the train he has equipped a chemical laboratory there. Man will some day know how to see events that are taking place in distant places. I hold the secret of doing this now, Progress, and if you like I will show you what is taking place in Edison's laboratory on the train at this very minute."

Progress. "Do show me."

Scene I. Edison Experiments in Car

(*In corner of a car a small printing press is seen. Rows of small bottles on shelves and a box for a table. Edison holds up a flask full of water containing a solution of phenolphthalein, pours alkali from bottle to flask and color appears, speaks to himself.*)

Edison. "Well, that is interesting. Chemistry is certainly a wonderful study. Every week that I sell all my papers, I can buy more chemicals, and every time I buy more chemicals, I can do more experiments and learn more about things."

(*Edison dips a piece of white cloth into congo red solution, takes it out, wrings it and shows it red. Dips it into dilute acid, wrings it, and shows it is blue.* "Wonderful, perfectly wonderful." *While Edison is talking and experimenting, the conductor and a brakeman enter and stand at one side without noticing Edison. Appear to be talking to each other.*)

Edison. (*Reading—then speaks*)[1] "It says here that hydrogen can speak. All you need to do is to mix it with oxygen and make soap bubbles with the mixture. Then slightly warm with a flame." (*Takes bottle of mixture previously prepared and drives gas out by pouring water in through one tube and lets gas bubble into dish of soap solution through outlet tube.*) "I have the mixture." (*Makes bubbles and removes bottle of mixture.*) "Now there are the bubbles on top of the soap solution. I wonder if it is a soft voice." (*Brings lighted stick to bubbles — loud explosion follows.*) "Oh! Ah! What a loud voice!" (*Dances in glee.*) "That is certainly great!" (*Some papers are set on fire.*[2] *Conductor and brakeman excitedly cry, "Fire! Edison extinguishes the fire with a towel.*)

Conductor. (*Rushes over just as Edison has extinguished the flames. Slaps Edison on the side of the head and shouts.*) "Young man, clear your infernal bottles out of this car. We can't take a chance of your killing us or burning us up any longer. Pack up or I'll dump them all out the door." (*Edison gathers bottles together, putting one hand to his ear as if it hurt him, as the curtains are drawn.*)

(*Curtain*)

Science. "That harsh blow of the conductor was severe on Edison. He not only lost the chance to fill in time with experiments but he partially lost his hearing. Edison spent only three months of his life in school. But in spite of all his handicaps, he had determination and a will to work. He made good use of his time.

"When 15 years of age by his alert action he saved the young son of the station agent from being run over by a train. In appreciation, the station agent taught Edison train telegraphy. So persistently did Edison keep at his study and practice of sending and receiving the Morse code that in four months we find him ready to take a job with the U. S. Military Telegraph Corps."

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1 This experiment should be done only under the direction of the chemistry instructor, because of the dangerous properties of a mixture of oxygen and hydrogen in the presence of a flame.

2 Arranged so that Edison spills a little carbon disulphide solution of phosphorus upon a piece of filter paper just as he sets off the hydrogen mixture. This also requires guidance from the chemistry instructor.

Progress. "I have seen him. You see I have followed events in telegraphy for over 20 years and Edison has figured in it of late. For five arduous years Edison wandered through Canada and various cities of the U. S. from Canada to the gulf, a roving telegraph operator. I know he was as expert in telegraphy as anyone in the country, but I have now lost track of him."

Science. "Well, he has just gone to Boston. He is rather uncouth, poorly dressed and is applying for a job at the Western Union office where the night operators try to put up a job on the boy from the Woolly West to discredit him. Look, you may see and hear as well."

Scene II. Edison at the Western Union Office in Boston

(*Stage setting—Manager's desk, several tables with telegraph instruments set up and some of them clicking, several operators taking messages, the Manager at his desk, the Secretary announces to the Manager.*)

Secretary. "A young man wishes to see you about a job, sir."

Manager Milliken. "Send him in."

(*Edison rather shabbily dressed enters. The other operators upon seeing him show amusement and poke fun at him among themselves.*)

Edison. "Mr. Adams wrote me that he thought you could use me in your office."

Manager. "Can you send?"

Edison. "Yes, sir."

Manager. "Can you receive press copy?"

Edison. "Yes, sir."

Manager. "When can you begin?"

Edison. "Now."

Manager. "Well, report for night work. Come back at 5:30."

Edison. "Thank you, sir. I will be here." (*Edison goes out.*)

Manager. "Boys, I have a new man to help you out tonight. I am told he is a good man. Show him some courtesy and make him feel at home. Good night." (*Exit.*)

Operator 1. "Some guy — eh!"

Operator 2. "Let's give him the 'salt,' what?"

Operator 1. "Say, Bob, call up New York, get their fastest man, Number 1, to send in a long article for the Boston Herald and to do his fastest."

Bob. "O. K." (*Clicks off on telegraph instrument*) "It's all fixed, fellers. Now it's almost time for the fun to begin."

Operator 2. (Looking out) "Here comes the rube. Bob, you give him his orders." (*Edison enters.*) "Hello, Eddie."

Edison. "Hello."

Bob. "Have you ever received before?"

Edison. "Oh, yes."

Bob. "Where?"

Edison. "In a number of places out West."

Bob. "We have an important press report due from New York, on Number 1 wire, tonight. Will you handle it for us?" (*Hands Edison a pen.*)

Edison. "Certainly, I'll do my best." (*Sounder clicks.*)

Operator 1. "I think Number 1 is calling now. Here, Edison, this is your table here. Go to it."

(*Edison sits down, opens key and sends a few letters, closes switch and settles down to write as instrument clicks off the message. It comes slowly but soon the speed increases — writes slowly at first, then more rapidly and still more rapidly. The other operators soon peer over Edison's shoulder and watch him write and exchange glances. At length, Edison glances up and observes the others having fun over his endeavor to keep up, but he keeps on. Finally, Edison opens his switch, the clicking stops. Edison looks up, smiles and speaks.*)

Edison. "Say, boys, this New York chap is so slow I think he is sending with his foot. I am going to ask him to change off and send with his other foot." (*Edison closes his switch and operates his key and sounder. Closes, and clicks some back.*) "Well, he says he's tired and will get another operator to finish the report."

Operator 1. (*Takes up some sheets of Edison's copy and passes them around.*) "Say, Bob, look at that report; every word clear as a bell. Even *you* can't do a job like that!"

Operator 2. "He's put us on the blink all right, all right, we'll have to admit."

Bob. "Shake, Edison." (*Puts out his hand. Edison*

shakes.) "We thought we were going to 'salt' you down on this job, but you've beaten anything we could do, so we'll take our turn at it now, and we hope you won't be angry with us."

Edison. "No, no, my friend, I'm just getting warmed up, I'll take the rest of it. This is nothing unusual for me." (*Continues writing.*)

(*Curtain*)

Progress. "Not only have you found men to invent the steam engine and the telegraph which have already done much to advance civilization, but I see, Science, that your boy Edison, now a young man, in addition to being a master at his trade of telegraphy is showing some ability as an inventor."

Science. "Yes, while in Boston he got his first patent. It was for a vote recorder. If put into Congress they could take the vote in two minutes instead of two hours. But when it was explained to the leaders in Congress they said, 'If there is any machine we don't want, it is that. We don't want to be progressive to that extent. It would be a great blow to filibustering to have that. No, no — take it away!!' "

Progress. "There always have been stumbling blocks and we must expect them in the future. But I am not at all disheartened. They cannot endure forever."

Science. "Oh, Progress! I have some interesting news. Edison spent on his inventions more than he earned, went to New York in hopes to earn more than $75 a month, and to sell a stock ticker he had invented. Shabby, cold, hungry and in debt, he spent his time while waiting for a job studying the workings of the stock ticker used in sending quotations from the floor of the Gold Room. Having a stock ticker patent himself to sell, Edison quickly saw how this one worked. Suddenly the complicated sending instrument snapped and stopped. There was bedlam from hundreds of brokers' boys who rushed in to say their brokers' wires were out of order. No one seemed to know what to do. Edison quickly saw the trouble and offered to fix it. He did this in a very few minutes. He was then offered a job in charge of the electrical equipment at $300 a month. Edison was asked to make improvements in the ticker if he could. He quickly saw ways to do this and invented an improved ticker which he thought should bring him $3,000 to $5,000. He has been called to the president's office to discuss the sale of his patent. Let us watch."

SCENE III. EDISON RECEIVES HIS FIRST BANK CHECK

(*Stage divided by a screen in middle. One side to represent office of General Lafferts, president of the Gold & Stock Telegraph Company — the other to represent a bank with teller's window. Secretary arranges papers on General Lafferts' desk as Edison knocks.*)

Secretary. "Come in." (*Edison enters.*)

Edison. "Did General Lafferts wish to see me?"

Secretary. "Yes, sit right down. He will be here directly." (*Exit.*)

Edison. (*Sits*) "I suppose he wants to know about my new ticker—I hope he buys it. I wonder if I could ask him $5,000. for it. No, I guess $3,000. is all it is worth. I don't know as it is worth that—but I ought to get something for it I am sure. He is paying me pretty well, I wonder if he expects me to give it to the company?" (*General Lafferts enters, greets Edison and sits at desk. Edison stands.*)

General. "Well, Edison, I asked you when I engaged you to see if you could improve our ticker system and I hear you have made some new inventions. I think now we ought to close up this matter. How much do you want for them?"

Edison. (*Bashfully*) "I don't quite know, General, why don't you make me an offer?"

General. "I will, if that suits you better, what would you say to $40,000?"

Edison. (*Almost fainting, stammers*) "Well, I guess that is fair enough."

General. "All right, I have a contract all drawn except for filling in the amount, (*writes*) now that is all right for you to sign." (*Passes it to Edison who signs and returns it.*)

General. (*Writes out check*) "Here, Edison, is a check for $40,000. You can get your money at the bank at William and Wall Streets. We are all highly appreciative of the high quality of your inventions which I am sure will keep our company in the lead for many years." (*Hands check to Edison.*)

Edison. (*Takes check*) "Thank you, General, very much, you have been very generous with me." (*Passes out of the office.*)

Edison. (*Has on overcoat, enters bank. Enquires of man how to get his check checked, is directed to teller's window,*

passes check in at teller's window and asks) "Can you give me the money for that?"

Teller. (*Takes check, reads, turns over, hands back*) "You must endorse it first and have some one to identify you."

Edison. (*Takes it back. Didn't hear or understand what teller said, walks away.*) "I might have known this couldn't be worth real money. No one would give me $40,000. of real money for my ticker. Guess I'll go and see why the General tried to trick me like this." (*Goes out and off stage.*)

Edison. (*Without overcoat knocks at General's office, secretary opens, asks*) "May I see General Lafferts?"

Secretary. "Come in." (*Goes to General.*) "Edison wishes to see you."

General. "Send him here."

Secretary. "All right, the General will see you."

Edison. "Thanks." (*Advances to the General's desk, throws check on table.*) "What does this mean? They wouldn't give me any money. I passed it in and they immediately passed it back."

General. (*Laughs heartily.*) "He didn't know you, did he?" (*Turns check over.*) "And you haven't endorsed it. You must write your name on the back and have someone go with you that knows both you and the bank teller. Here, John, you go over and identify him, will you?"

Secretary. "All right." (*Secretary and Edison exit.*)

General. (*Laughing*) "Wish you success this time Edison."

(*Edison and John enter bank, go to teller's window. Edison has overcoat on.*)

Secretary. "Hey, Will. This is Thomas Edison. He's O. K. He has a big check but wants lots of small bills. Can you fit him out?"

Teller. "He came in earlier, but I didn't know him from Adam and besides his check wasn't endorsed."

(*Edison passes in the endorsed check.*)

Teller. "How will you have it?"

Edison. "In money please."

Teller. "Will small bills be all right?"

Edison. "Any way."

(*Teller picks out rolls of bills, counts and passes out roll after roll until Edison's overcoat pockets are all bulging out with rolls of bank notes. Teller and secretary smile.*)

Edison. (*To teller*) "Thank you." (*Edison and secretary start out, Edison says to secretary*) "Thank you, too, I don't know what to do with so much money. I hope I'm not robbed."

(*Curtain*)

Science. "If you could but follow with me you would see Edison in his home in Newark. There he sits up all night to see that no one breaks in to steal his money. And in the morning he goes with all his money to General Lafferts again, who after another good laugh explains to him how to open a bank account.

"Edison now builds a factory and employs fifty men to build stock tickers. His shop runs day and night. He is foreman on both shifts. By sleeping half an hour at a time four times in the twenty-four he is able to keep going and turn out new inventions at the same time."

Progress. "I know of no other human machine that has run as energetically, tirelessly, and effectively with as little time for rest as the body of your inventor Edison."

Science. "Perhaps it was Edison's habit of working eighteen hours or more out of twenty-four that filled him with a strong desire to improve the artificial light. He spent years of time and a hundred thousand dollars in money in trying to perfect the incandescent electric lamp. October 20, 1879, in the Edison Laboratory at Menlo Park, N. J., a new lamp was ready for testing. Wouldn't you like to visit the laboratory and see the test under way?"

SCENE IV. LAMP TEST IN LABORATORY AT MENLO PARK — 1879

(*Equipment — A tall, upright board on base, holding glass tubes to represent mercury pump, and a large bottle at a higher level for mercury reservoir. Just below bottle level is the lamp to be tested. Use a replica of Edison's first lamp. One wire of 110-volt current is attached to one terminal of lamp. A rubber tube extends from the tip of bulb to apparatus on board. Edison is busy with apparatus on one bench and Mr. Jehl is working at the mercury pump. Two or three others are working at the tables. The laboratory is lighted with gas.*)

Jehl. "This pump has been working now for nearly 10 hours. I think the vacuum needs a little heat to expand and

drive out the last of the air." (*Edison comes over. Jehl mounts step ladder and holds jar as if to pour mercury into receiver. Edison lights match and holds it near bulb as if to warm it. He then makes several quick contacts of the loose wire with the lamp so that the filament flashes — listens carefully as he lights up the filament.*)

Edison. "That sounds like a high vacuum, there can't be more than one one-millionth of an atmosphere left." (*Holds connection on for about 10 seconds so lamp is lighted — disconnects lamp and motions Boehm.*) "Boehm, this lamp is ready for you to seal now and then we'll test it." (*Boehm comes over with blow pipe and alcohol lamp in hand.*)

Science. "Please, may I interrupt this scene a moment?"

(*Curtains are drawn*)

Science. "You have been witnessing the experiment, which, after thousands of trials, thousands of tests, and thousands of failures was at last a success. The lamp was exhausted on the evening of Oct. 19, 1879. It was sealed and lighted. Jehl and Edison sat up all night watching it. The lamp burned all day, Oct. 20, all night Oct. 20 and until 2 P. M., Oct. 21 — over 40 hours — then Edison feeling that it was a success tried to see if it would stand a higher voltage. He made it burn with dazzling brightness for a time and then it burned out. Shall we take one more glimpse into the laboratory while they still watch the new lamp?"

(*Open curtains*)

(*A crowd of half a dozen men including Edison, Boehm, and Batcheler. Lamp is burning in same place but tube is disconnected from tip.*)

Observer No. 1. "What is the filament made of?"

Batcheler. We took a piece of cotton thread, carbonized it within the furnace and used that."

Observer No. 2. "Looks to me as if we might get rid of our gas lighting in the laboratory pretty soon. I call that light a whizz."

(*Jehl enters*) "Edison, there is a New York Herald reporter outside who is after news. Shall we tell him you have made a successful lamp?"

Edison. "Yes, I am much encouraged. This lamp has now burned nearly forty hours and I know I can make one that will burn hundreds of hours. Tell him we have succeeded in making a successful incandescent lamp."

(*Curtain*)

Progress. "The invention of the electric lamp alone is enough to give its inventor immortal fame. Now let us come down to the present day. I understand your Edison has done many things in promoting the progress of the world."

Science. "You are quite right. In the fifty years that have elapsed since Edison made the first successful incandescent lamp he has taken out more than one thousand patents. The radio tube was developed from the lamp; the microphone is Edison's invention; dynamos; the phonograph, dictaphone; motion picture camera; talking pictures; storage batteries; cement-making process; magnetic iron ore extractors; are but a few of his important inventions and today, at the age of eighty-three, he is still inventing."

Progress. "Science, you have been a great help to me. I can see thousands of alert scientists today for only one of a hundred years ago. Behold the bright picture of the future when man will be relieved of drudgery, will be surrounded by more comforts, and will have more time to think out and work out still more wonderful things. We need more men like Edison who credits genius with being 2% inspiration and 98% perspiration, but men who also enjoy as he does the perspiration part of genius."

Science. "It is boys of this type that I am looking for. It was 83 years ago this Feb. 11, that Edison was born in Milan, Ohio. He has had about every honor man can give bestowed upon him — a Congressional medal, medals from foreign countries, a Government stamp issued commemorating his incandescent lamp, and last fall the whole world celebrated *Light's Golden Jubilee.* But perhaps the greatest satisfaction is in living to see how successful his many inventions have been."

"Come, Progress, will you now go with me — I must go to Florida where Edison is trying to grow plants which will produce rubber in commercial quantities."

Progress. "Yes, I will go with you, we must ever be moving, else we make no progress."

(*Both leave arm in arm*)

A TRIBUTE TO THOMAS A. EDISON.[3]

The whole world lays its tribute at the feet
Of one who toiled long years with ceaseless care
To make men's lives more useful and complete,
To spread his inspiration everywhere;
In home and mart today shines forth the light
Which, born of genius rare, has conquered night.

How fitting that a grateful people praise
His name of names and through the hours dark
Bright rays of flaming beauty upward blaze
The bound of fifty years' success to mark.
Our generation glories in his worth
And those who follow us will glory too,
As science spreads her tribute o'er the earth;
"The world progressed because men lived like you!"

—*Inez Wilcox Dennison.*

3 From "Edison Life," October, 1929.

Helpful references: New International Encyclopedia; Forman: Stories of Useful Inventions; General Science Quarterly, Volume 5, No. 3, March, 1921; and Volume 12, No. 4, May, 1928; Kaempffert: A Popular History of Electric Light, Smithsonian Miscellaneous Collections, Volume 76, No. 2; Dyer and Martin: Edison: His Life and Inventions, 2 vols., Harper Bros.

EDISON FILMS

The Benefactor. Film No. 20 .....3 reels
"The Benefactor" tells the story of Edison's life. Beginning with his early boyhood at Milan, Ohio, his birthplace, the picture reviews many interesting events in Mr. Edison's career, including the formation of the first firm of electrical engineers, the inventor's untiring efforts, and the scientific triumphs through which he has conferred great and permanent benefits on mankind.

Thomas A. Edison. Film No. 41.....1 reel
Forty years after Edison invented the incandescent lamp, he was the guest of honor at the laboratories of the General Electric Company in Schenectady. This picture gives intimate glimpses of the famous inventor as he inspected the methods employed in the development of his greatest contribution to modern life.

Making Mazda Lamps. Film No. 48.....1 reel
A short historical prelude is followed by the present development of artificial illumination. The successive processes in the manufacture of Mazda lamps is shown.

The three films described above are available in both standard (35 mm.) and 16 mm. widths. They are loaned free of charge, except for transportation. Address Visual Instruction Section of the General Electric Company, Schenectady, N. Y.

ILLUSTRATED LECTURES

Incandescent Lamps. Lecture No. 8. Glass slides only. Historical beginning with the Edison invention of 1879.
Incandescent Lamps. Lecture No. 9. Glass slides only. The manufacture of electric lamps.
These sets of slides with prepared lectures are also loaned, free of charge, except transportation, by the General Electric Company.

The New Books

Agricultural Nature Study, Book I—1929—John H. Gehrs—184 pages—illustrated—three colored plates—American Book Company.

This book supplies practical information about common objects in nature, in language adapted to intermediate grade children. The main divisions of the book are: 1. Domestication and improvement of animals and plants. 2. Birds. 3. Natural protection of animals. 4. Trees.

Advanced Biology—1929—Frank M. Wheat and Elizabeth M. Fitzpatrick—587 pages—illustrated—American Book Company.

This attractive book, as its title suggests, assumes previous study of biology. The historical treatment given to many subjects is a special feature. Each chapter opens with stimulating thought questions and ends with questions and suggestions designed to help the pupil to organize the important principles treated in the text. The illustrations are particularly fine; some in colors. The book is one that makes a strong appeal to one who uses it.

A Chemical Dictionary—1929—Ingo D. W. Hackh—790 pages—illustrated—$10.00—Blakiston's Son and Company.

This is a comprehensive work which states clearly and precisely the theories and laws of chemistry; gives accurate description of elements, compounds, minerals. drugs, vegetable and animal products, and chemical equipment; and treats briefly the investigators who have built up this science, giving photographs of many of them. Teachers and others will find here the meanings of modern technical words used in chemistry which are not yet listed in the common dictionaries. As a reference work it stands alone in its field.

High School Geography—Revised—1929—R. H. Whitbeck—574 pages—384 illustrations—$2.00—The Macmillan Company.

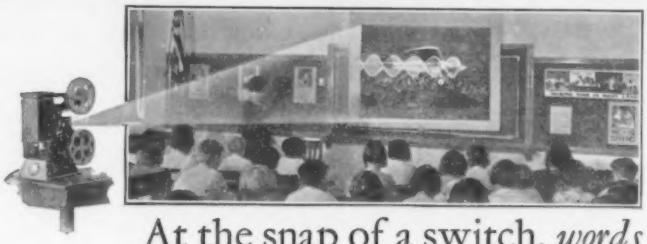
This is a geography text which attempts to interrelate the physical environment of man and selected human activities. In the revision the physical aspects have been little changed, but those chapters dealing with the human side of geography have been thoroughly revised. The illustrations are excellent, and there are eight maps in color. Summaries and exercises at the chapter ends facilitate review work.

The Terminology of Physical Science—1929—Diane Roller—115 pages—paper cover—$1.50—University of Oklahoma Press, Norman, Oklahoma.

A very useful book for any science teacher. In six chapters are treated: Various terms and their definitions; common prefixes and suffixes; the names of the chemical elements; the pronouns usd in science; the spelling of words used in science; simpler standard abbreviations.

Colloid Chemistry—Third edition—1929—Jerome Alexander—270 pp.—$3.00—D. Van Nostrand.

A very good book for the science teacher interested in the practical applications of colloidal chemistry. After a very good treatment covering definitions, classifications, and essential technical matters, the practical applications are given. These include: astronomy, meteorology, perfumes. agriculture, ceramics, dyeing, celluloid, explosives, paints, soaps, petroleum, filtration, photography, rubber, milk, glass, pharmacy and therapeutics, digestion, and many more.



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Instruction Tests in Chemistry—1930—Earl R. Glenn and Louis E. Welton—76 pages—World Book Co.

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A Course in English for Engineers—1930—Carl A. Naether—330 pp. —$2.60.

This book fills the existing need for a thorough course in English for engineers. It places emphasis on the forms of speaking and writing most needed professionally by the engineer, yet it is not, narrowly technical and will be found helpful for business students as well. The text distinguishes clearly and forcefully between the different styles of composition, and a wealth of interesting specimens illustrate each style. The appendix contains the technical details of composition. It is a text which will inevitably prove a genuine aid to the engineer striving to improve his writing, whether he be a student or an expert n the field.

Principles and Practice of Electrocardiography—1929—Carl J. Wiggers—226 pages—61 illustrations—$7.50—C. V. Mosby Co.

The book is divided into three sections:

1. General principles and procedures of electrocardiography.
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Obviously this is a book for the physician or medical student.

Introduction to Physical Optics—1929—J. K. Robertson—422 pages —223 illustrations—$4.00—D. Van Nostrand Co., Inc.

To meet the needs of students who wish a course between an elementary and an advanced treatment of physical optics, the author has prepared this book. It will help to lay a foundation for those who expect to specialize in the theory of optics and will be helpful to others who wish a general knowledge of the modern views of light.

Electron Physics—1929—J. Barton Hoag—208 pages—illustrated—$3.00—D. Van Nostrand Co., Inc.

A year of college physics ought to be a prerequisite to undertaking a study of this book whose aim is to present evidence for many of the concepts of modern physics. Many interesting experiments are described which can be carried out in the college laboratory.

The Science of Nutrition Simplified—1929—D. D. Rosewarme—314 pages—illustrated—$3.50—The C. V. Mosby Company.

A book on nutrition for the ordinary reader. Part I takes up formations of foods, nutrition, physiological considerations and methods of dietetics. Part II describes food requirements of the organism. Part III treats food substances. Part IV is on dieting.

Pettibone's Text Book of Physiological Chemistry—4th edition—1929—rewritten by J. F. McClendon—368 pages—$3.75—The C. V. Mosby Company.

Part I is text. Part II, nearly half the book, is devoted to laboratory work. The book covers the general field of physiological chemistry and fundamental processes which go on in the animal body. It is of college grade and requires some knowledge of organic and physiological chemistry.

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Report of Annual Meeting of the New York State Science Teachers' Association

The New York State Science Teachers' Association held its annual meeting at Syracuse, December 26th and 27th. President Harlan P. Freeman, of Niagara Falls High School, presided.

Several resolutions of importance were passed, among which were the following:

RESOLVED:

1. That the New York State Science Teachers' Association continue the work of the Teacher Placement Committee.
2. That the New York State Science Teachers' Association approve of the action taken by the State Examination Board with reference to a sequence in Science, involving specifically:
    1. The establishment of a tenth-year course in General Biology to follow General Science in the ninth year.
    2. The granting of two units in Science upon the completion of an advanced Science, such as General Biology, Physics, Chemistry, Physical Geography or Advanced Biology, providing these courses have been preceded by General Science in the ninth year.
3. That the New York State Science Teachers' Association recommend the changing of the requirement for the College Entrance Diploma so as to read: "Latin or Greek or French or Spanish or German or Italian Three Years or Three Years of Science."

The Association expressed by resolutions its appreciation to the Associated Academic Principals, to Superintendent Alverson of Syracuse, and to others for assistance rendered and also to all who contributed to the program.

The program consisted of addresses as follows:

Mr Warren W. Knox, State Supervisor of Science, spoke on "Problems of Science Sequence."

Prof. A. J. King, of Syracuse University, gave an address on "The Use of X-Rays in Chemistry."

Mr. A. K. Getman, of the State Department of Education, talked on the subject of "Elementary School Science."

A symposium was led by Mr. K. M. Humphrey and by Miss Hewitt, both of Vocational High School, Syracuse, on the topic, "Supplementary Reading in Science." Mr. John A. Baird, East High School, Rochester, discussed the subject, "Failures in our Sciences."

Mr. Ellis L. Manning, of the General Electric Research Laboratory, Schenectady, closed the program with an address on "Vacuum Tubes."

The keynote of the meeting was the desire to have the sequence of Science subjects and the College Entrance Diploma so arranged that the science-minded pupil may have equal opportunity with the language-minded pupil; i. e., that he may

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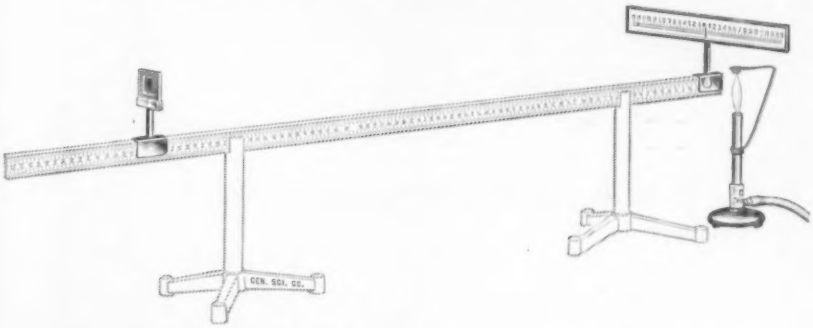

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present three years of Science instead of three years of Language for his diploma. For the coming year the Association will work for the adoption of such a plan and for the advancement of the Science teachers who become members.

The following officers were elected for the coming year:

President—K. M. Humphrey, Vocational High School, Syracuse.
Vice-President—A. J. Burdick, Utica Free Academy.
Secretary-Treasurer—Miss Lucy E. Latham, Sherrill High School.
Members of the Council for 1930-1932—Harlan P. Freeman, Niagara Falls High School; George W. Fowler, Central High School, Syracuse, and W. Earle Sutherland, Albany High School.

Science Articles in Current Periodicals

AVIATION

Gentlemen Adventurers of the Sea. Nat. Geog. Mag., 56:597, Nov., 1929.

Are Fliers Born or Made? Pop. Mech., 53:26, Jan., 1930.

How Safe is Flying? Pop. Mech., 56:1, Jan., 1930.

The Gyroscope on the Airplane. Lit. Dig., 103:11:33, Dec. 14, 1929.

Byrd "Bags" the Second Pole by Air. Lit. Dig., 103:11:9, Dec. 14, 1929.

Space Rockets in Germany. Lit. Dig., 103:12:16, Dec. 21, 1929.

Cheapest Modern Mode of Travel. Com'l Amer., 26:6:42, Dec., 1929.

Automatic Radio Beacon Guides Plane in Fog. Pop. Mech., 52:401, Sept., 1929.

Flying the Air Liner. Pop. Mech., 52:360, Sept., 1929.

ASTRONOMY

The Earth Is Two Billion Years Old. Pop. Sci. Mo., 116:1:4, Jan., 1930.

The Moon Is Made of Cinders. Pop. Sci. Mo., 115:6, Dec., 1929.

AUTOMOBILE

The Front Drive and Why. Pop. Mech., 53:10, Jan., 1930.

BRIDGES

Wires and Cables for a Great Bridge. Sci. Amer., 141:518, Dec., 1929.

CHEMISTRY

Normal and Teachers College Essays. Jo. Chem. Ed., 6:1681-1715, Oct., 1929.

DANUBE

The Danube, Highway of Races. Nat. Geog., 56:643, Dec., 1929.

ELECTRICITY

The History of Electricity Before Discovery of Voltaic Pile. Jo. Chem. Ed., 6:1726, Oct., 1929.

FIRE

Thrills of the Fire Fighters. Pop. Mech., 52:204, Aug., 1929.

FLOWERS

Using Bulbs for Early Indoor Bloom. Amer. Home, 3:158, Nov., 1929.

A New View of Garden Color. Amer. Home, 3:159, Nov., 1929.

Those Holiday Gift Plants. Amer. Home, 3:356, Jan., 1930.

Dahlia Roll of Honor. Amer. Home, 3:270, Dec., 1929.

FOOD

Our Food and Our Teeth (Calcium and Vitamin Sources). Hygeia, 7:1212, Dec., 1929.

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Drake University, Des Moines, Iowa
LA VERNE ARGABRIGHT, *Secretary*
Western State Teachers College, Kalamazoo, Michigan

MORNING SESSION 9 o'clock

SYMPOSIUM :

Research and Experimental Work in Elementary Science

"The Articulation of Elementary Science with Other Subjects in the Elementary School"
ERNEST HORN—College of Education, University of Iowa

"Problems in the Training of Teachers of Elementary Science"
NED H. DEARBORN—School of Education, New York University

Report of Research Committee:
E. R. DOWNING—School of Education, University of Chicago

"A Technique for Developing Content for a Professional Course in Science for Teachers in Elementary School"
FLORENCE BILLIG—Supervisor of Science, Sacramento, California

"Comparison of Results of Different Methods of Instruction in Nature Education in Primary Grades"
JENNIE SMITH—Detroit Teachers College, Detroit, Michigan

"The Elementary Science Room and Its Equipment"
ZOE SHAW—Later Elementary Supervisor, Kalamazoo, Michigan

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AFTERNOON SESSION

SYMPOSIUM :

New Courses of Study in Elementary Science

"Grand Rapids Course of Study in Elementary Science"
HELEN K. McINTOSH—Elementary Supervisor, Grand Rapids, Michigan

"New Jersey Course of Study in Nature Study and Elementary Science"
G. V. BRUCE—Head of Science Department, Summit, New Jersey
Discussion led by CHAS. PIEPER, School of Education, New York Univ.

"The Work of the Cleveland Curriculum Center in Elementary Science"
HELEN K. BRETT—Principal, Doan School, Cleveland, Ohio
Discussion led by ANDREW LESTER, Pittsburgh Teachers College

"Pittsburg Course of Study in Elementary Science"
JOHN HOLLINGER—Department of Public Instruction, Pittsburgh, Pa.
Discussion led by MORRIS MEISTER, New York College for Teachers

"The New York State Course of Study in Elementary Science"
GERALD S. CRAIG—Teachers College, Columbia University
Discussion led by E. LAWRENCE PALMER, Cornell Univ, Ithaca, N. Y.

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American City. 443 Fourth Ave., New York City. Monthly. $4.00 a year, 50c a copy. The science problems of city and rural communities are treated in numerous articles, well illustrated. A valuable student and teacher reference.

Commercial America. Philadelphia Commercial Museum, Philadelphia, Pa. $2.00 a year. Ill. Commercial production. New inventions. Will interest commercial geography and science teachers.

Current Science. 40 South 3rd St., Columbus, Ohio. Weekly during school year. $1.00 per year. This is a student's news sheet, giving interesting science news of the world; it will add life to the work of the general science class.

The Educational Screen. 5 South Wabash Ave., Chicago. 10 months. 25c a copy, $2.00 a year; with "1000 and One Films," $2.25 a year. Discusses the use of motion pictures, slides, and other visual aids in our schools; gives brief descriptions of educational films, and lists of theatrical films which are suitable for children. The journal is entirely educational, having no commercial affiliations.

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The American Home. Garden City, N. Y. Monthly. $1.00 a year. Helpful suggestions to the amateur gardener, home maker, teacher and pupil.

Science Education. Salem, Mass, Quarterly. 40c a copy. $1.50 a year. The only journal published devoted alone to science in the elementary and secondary schools. It tells what schools are doing in science, gives lesson plans, demonstrations, and an extensive bibliography of usable articles in current periodicals.

The Guide to Nature. Sound Beach, Conn. Monthly. 15c a copy, $1.50 a year. Ill. Of interest to elementary pupils and teachers of nature study.

Hygeia. 535 North Dearborn St., Chicago. Monthly. 25c a copy, $3.00 a year. Popular articles on individual and community health. A valuable supplement to classroom work in hygiene.

Industrial and Engineering Chemistry. Box 505, Washington, D. C. Monthly. 75c a copy, $7.50 a year. A technical journal which contains much material which teachers can use.

Journal of Chemical Education. 85 Beaver Street, New York, N. Y. Monthly. $2.00 a year. Promotes chemical education; primarily a journal for the chemistry teacher. Digests of activities of chemical associations.

Journal of the Franklin Institute. Philadelphia, Pa. Monthly. 50c a copy, $6.00 a year. Ill. A technical journal. Contains many articles of value to science teachers.

Journal of Home Economics. 617 Mills Bldg., 700 17th Street N. W., Washington, D. C. Monthly. 25c a copy, $2.50 a year. For teachers.

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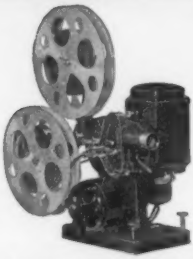

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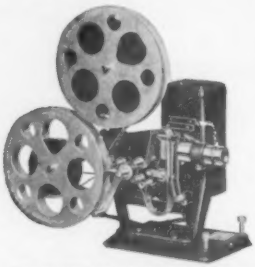

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Photo-Era Magazine. Wolfeboro, New Hampshire. Monthly. 25c a copy, $2.50 a year. This magazine is for the beginner, the advanced amateur, and the professional photographer. It has much for the science department of universities, schools and summer camps, and will help instructors and pupils to make better photographs.

Popular Mechanics Magazine. 200 E. Ontario St., Chicago. Monthly, 25c a copy, $2.50 a year. A popular scientific magazine, covering in well illustrated articles developments of general interest in all branches of science and mechanics, in a form usable in classroom work.

Popular Science Monthly. 225 West 39th Street, New York City. Monthly. $2.50 a year, 25c a copy. A review in text and pictures of the news of science and invention, presented in a humanistic and inspirational way. Used as a supplement to text-books in many high schools. Valuable to science pupils and teachers.

Radio. Pacific Building, San Francisco, California. Monthly, 25c a copy, $2.50 a year. Devoted to the technique of radio. Of special interest to science teachers. It gives an explanation of why and how radio equipment works.

Radio News. 53 Park Place, New York City. 25c a copy, $2.50 per year. Monthly. A practical periodical for all who are interested in radio. Gives radio progress, new hook-ups, and gives much help to one who may wish to construct his own set.

School Science and Mathematics. Chicago. Monthly. $2.50 a year. A teacher's journal. Includes many helpful suggestions.

Science Classroom. Issued by "Popular Science Monthly," October to June. 25c a year. A valuable teacher's aid, giving lesson plans, experiments, and many reference suggestions for secondary science teachers.

Scientific American. 24 West 40th St., New York. Monthly. 35c a copy, $4.00 a year. Has longer articles than the other popular science journals. Illustrated. Particularly valuable to high school science pupils and teachers.

Science and Invention. 53 Park Place, New York City. Monthly. 25c per copy, $2.50 a year. Ill. Popular articles on astronomy, physics, photography, radio-activity, medicine, and, in fact, science in general.

Scientific Monthly. Garrison, N. Y. 50c a copy, $5.00 a year. Articles, as a rule, are more along lines of pure science. Much of value to teachers. Articles can be read to advantage by many pupils.

Science News-Letter. Science Service, 1115 Connecticut Ave., Washington, D. C. Weekly. 10c a copy, $5.00 a year. Gives a valuable current summary of the progress of science, in a form usable in science classes.

Transactions of the Illuminating Engineering Society. 29 West 39th Street, New York. Monthly. $1.00 a copy, $7.50 a year. Technical. Many articles contain material which can be used in high school classes.